VOLUME XXXIV NUMBER 1

INDIAN FORESTER

JANUARY, 1908.

FORESTS AND WATER-SUPPLY.

Over a great portion of Northern India there is just now a marked scarcity of water. This, therefore, seems to be a suitable time for us to consider the matter of water-supply. Are we doing all that is possible to make the most of the water resources of the country or are we through negligence allowing the supply of water in India to run to waste? In the November number of the *Indian Forester* we attempted to point out the advantage which agriculture would derive from suitably situated forests. We now wish to bring forward the enormous importance of forests with regard to the conservation of the water-supply. The importance of forests in this respect is becoming generally known in most countries, more especially in America, where the Forest and Irrigation Departments, if not one and the same, work closely together. for it is recognised that perhaps the most important function of forests especially in hot countries is the assistance they give in increasing and regulating the water-supply. It may be stated that

Pakhar (*Ficus infectoria*, Roxb) growing on a well-post at Dudwa,
Kheri Division, U. P.

Photo. Mechl. Dept., Thomason College, Roorkee. Photo by H. Hastings.

the nearer a country is to the equator the more important is the forest question.*

It is a well established fact that forests tend to increase the annual rainfall to a certain extent. In the plains the influence is comparatively small, but as the elevation increases the effect becomes considerable. The results of some experiments made in Prussia on this subject showed that near the sea-level the increased rainfall due to the influence of forests was about 1 per cent over the average rainfall of the open country, while at 2,500 feet elevation the increase was 43 per cent.

A much more important function performed by forests is the regulating of the water in the soil and of the moisture in the air. Forests have a powerful effect in retarding evaporation. Experiments in Prussia and Bavaria proved that under similar conditions the evaporation from a free surface of water in forest was only ·4 of that which took place in the open. The soil covering influences the degree of evaporation in a forest to a great extent. Dr. Ebenmayer's observations extending over five years proved that evaporation from forest soil without leaf mould was ·47 per cent of that from soil in the open and with a full layer of leaf mould was only ·22 per cent. [This indicates a substantial benefit arising from protection from fire.]

In addition to this effect on evaporation, forests hold back the rainfall from rushing into the nearest stream. Of the rain which falls on a forest, the crowns of the trees absorb about a quarter, and of the remainder which falls to the ground, a large quantity is retained temporarily by the humus and decaying vegetable matter. This water in part penetrates the ground and becomes available for absorption by the roots of trees and for the feeding of springs and in part gradually finds its way, *without causing erosion*, into the nearest stream. When there is scarcity of rain, or if the rain is not too continuous, these effects are most marked. In very heavy downpours after the humus is saturated, the effect is small. It has been found that a good layer of humus can absorb up to 5

* This and the following facts are taken from Schlich's Manual of Forestry, 1st ed., Vol. I, pp. 38 to 53.

inches of rain, and this will indicate the immense effect of forests in retarding the rainfall from running to waste.

The relative humidity of the air in forests is greater than in the open. Some experiments made in Bavaria showed that the relative humidity of the air in the forests was over 8 per cent more than that in the open. Dr. Schlich says that the greater relative humidity of the air in forests explains why dry air currents striking through forests become in a short time relatively moist so that precipitations may occur. At any rate, he states, that there can be no doubt that the formation of dew is much greater in the vicinity of forests than on open ground away from woodlands.

It thus becomes apparent that forests are a most important factor in connection with water-supply: (1) by increasing the rainfall, (2) by retarding evaporation, (3) by retarding the rainfall from running to waste, and (4) by increasing the humidity of the air and favouring the formation of dew. It seems to us that these potent effects of forests are not sufficiently recognized in India except by those who are acquainted with scientific forestry. With famine or scarcity repeatedly occurring, it is important that we should avail ourselves of every possible means of increasing and husbanding our water-supply. Yet at present we must confess that very little has been done to create forests in those parts where they are urgently needed. In the November number we advocated the gradual afforestation of all waste lands. Such afforestation, by creating an abundant supply of forest produce (and indirectly of manure), would be of immense advantage to agriculture, and now we have tried to indicate further advantages which such afforestation would afford in the increased and sustained supply of water. Is it not possible that afforestation of waste lands may be the true key to one of the most serious problems in India, *viz.*, the prevention of famine?

SCIENTIFIC PAPERS.

CAMPHOR.*

The scarcity of camphor was brought to notice in the extract from the *Indian Trade Journal*, which appeared in the *Indian Forester* for April 1907. It was pointed out that camphor which could at one time be purchased for 50*s*. per cwt. had risen to 400*s*. per cwt., and that even at this high rate large quantities could not be obtained. The extract enumerated the various industries which use large quantities of camphor and which are consequently seriously handicapped by the scarcity and high price of this commodity.

At present Formosa produces about 75 per cent of the world's supply of camphor, the remaining 25 per cent being produced by Japan and China. The manufacture of camphor in Formosa is confined to trees of fifty years old and upwards. The cutting of trees of less than 50 years in age is prohibited by the Camphor Bureau. At present the number of old trees in the island is not accurately known, but there is reason to believe that the number is much less than was announced a few years ago.

From recent investigations it appears that the old trees will, at the present rate of cutting, become exhausted in fifty years, but this is really only guess-work as the old trees now standing are chiefly in the mountainous eastern half of the island, which is for the most part under the control of savage tribes. Active measures have been taken during the last few years to bring under subjection these head-hunting savages who terrorise the Chinese engaged in the collection of raw camphor. From all directions the police cordon round the aborigines is being drawn closer, and in a few years it is hoped that there will be free access to all parts of the island. Besides this subjugation of the savage tribes there are other difficulties to be overcome. The mountains are covered with

* Chiefly compiled from the *Tropical Agriculturist*, *Indian Trade Journal* and the *Agricultural Bulletin* of the Straits and F. M. States.

dense forests and the construction of roads to facilitate the export of camphor will be an expensive and lengthy operation. The efficiency of labour is much reduced by the malaria and other fevers which prevail in these parts. A few years ago a thousand coolies were imported by a Japanese Company to extract camphor. The Company's reports state that 33 per cent of the men were incapacitated by fever. Last year twelve of them were decapitated by head-hunting savages. In the autumn of last year, a newspaper article states that a sanguinary battle was fought between the savages and 200 camphor labourers working in the district of Foroku : of the 200 men only one escaped to tell the tale of disaster. The Japanese sent a punitive expedition which destroyed some villages, but the savages fled into the forests and could not be caught.

With prosperous conditions obtaining throughout the civilised portions of the island, it is no wonder that the cooly labourer is reluctant to work in the camphor forests at a wage about equivalent to Re. 1-4-0 per diem when he can earn approximately half this amount in more peaceful occupations on the low lands. Thus the difficulties to be overcome in order to exploit the remaining camphor forests of the island are likely to make the cost of the commodity an ever-increasing quantity.

Until Japan took possession of the island nothing was done to replace the trees felled, and the natural reproduction which took place was found to be quite inadequate. The camphor tree grows readily from seed and requires but little attention. Since the organisation of the camphor monopoly in 1899, the Formosan Government adopted a system of afforestation which it is hoped will result in guaranteeing to the island a sustained yield. The Camphor Bureau provides three methods of replanting—(1) by Government agency, (2) by schools, village communities and agricultural societies and (3) by private enterprise. The Government nurseries supply, young plants to schools, villages and agricultural societies. Government also supplies young plants free to private concerns desirous of taking up this work ; it grants land free of rent if it is

Government land and even makes a present of it if the plantations thrive.

Government has planted about three million young trees since 1900, and has arranged to add half a million more annually. The trees planted in the mountainous parts are set out with the idea of prohibiting their utilisation for camphor until they are 50 years old. Those which are planted in the lowlands are set close together with a view to utilising their leaves, when they are about ten years old. These latter plantations are designated as camphor gardens, in contradistinction to the former which are intended to form camphor forests. In the way of cultivation or irrigation the young trees require no attention beyond an occasional clearing of the ground during the first few years. Unfortunately, a large proportion (one report says 70 per cent) of the young plants are generally lost as the Chinese are in the habit of burning off dry grass, and fires, so started, easily get out of control and overrun the planted areas. However, on the whole, it is evident that afforestation of camphor in Formosa is proceeding at a good pace.

The supply of seed is a difficulty. The Formosan trees seed well, but the seeds fall almost as soon as they are ripe, and if not picked within two days or so, they get blown away. Owing to the large export of seed to foreign countries from Japan, the Formosan authorities could not depend upon Japan for a supply. The Camphor Bureau is now protecting certain selected trees for seed. These are registered and may not be cut. It is anticipated that these arrangements will ensure a sufficient supply of seed in future.

A good deal of attention has recently been paid to the new process of distilling camphor from the leaves and twigs instead of from chips of wood which was up till recently the only process in use. The quality of the camphor thus obtained from leaves is said to be equal to that obtained from the wood. If this is really so plantations will commence to yield a return when about four years old; at this age it is estimated that an acre would produce about 50 lbs. of camphor. When eight years old, the estimated yield is

double this quantity. According to a report from the German Consul at Twatutia the high expectations as to the yield of camphor from the leaves have not yet been realised: the experiments cannot, however, be considered, as concluded since it is generally acknowledged that the plants must be four or five years old before the leaves can be utilised.

The Japanese started camphor plantations in the island of Quelpart in 1905 and these are said to be showing satisfactory results. Proposals are also under consideration for planting up large areas in Korea.

Reports from China state that while the Chinese are interesting themselves in the question of afforestation, up to the present nothing has been done towards the planting of new trees.

In the Straits Settlements the Director of Agriculture states that experiments have been made with the propagation of camphor by means of cuttings. The first trial was not successful owing to lack of supervision, but more have been struck and promise well. As the camphor does not fruit until it is some 30 or 40 years old it is important to learn how it can be propagated by cuttings. He goes on to say that while not recommending that the cultivation of camphor should be taken up over large areas, it must be remembered that the price of camphor is very high and the prospects of high profits are excellent. The growth of trees at the experimental station is most excellent and compares very favourably with trees of the same age in Ceylon, at higher elevations which are supposed to be more suitable for camphor. Some 300 trees at the experimental plantations at Batu Tiga, growing only a few feet above sea-level, have attained in two years a height of 12 to 14 feet.

In Ceylon, the planting of camphor is being taken up, and the same is being done on the Nilgiri plateau—(*vide* pp. 103—105 of the *Indian Forester* for February 1907).

Camphor trees thrive in the Nilgiris. The following measurements of a tree planted on 1st December 1899 in the Government Botanical Garden there are given below :—

Dates on which measurements were taken.			Height.		Girth at one foot from the ground.		Girth at four feet from the ground.	
			Ft.	in.	Ft.	in.	Ft.	in.
22nd	March	1901	7	9	...		...	
6th	,,	1902	12	4	0	8½	0	6
21st	,,	1903	18	4	...		0	9
30th	,,	1904	23	6	1	2	1	0
23rd	,,	1905	27	3	1	4½	1	2
26th	,,	1906	30	4	1	6½	1	4
26th	,,	1907	33	0	1	10	1	7½

In Dehra Dun too the tree grows well, there being a fine avenue of these trees in the Chandbagh estate which is being negotiated for by the Forest Department.

In German East Africa arrangements for the extensive cultivation of camphor trees are being made. The species promises to thrive well, and it is the desire of the German authorities "to follow the example of other countries and make ourselves independent of the Japanese production which more and more degenerates into a farming of the monopoly."

In Algeria the cultivation of camphor is receiving attention, and it appears that, contrary to the views previously held, the camphor trees grown there contain as much camphor as those in Formosa.

For some time past America has foreseen the present scarcity of camphor and the Department of Agriculture has been distributing seed of *Cinnamonum Camphora* in the Southern and Pacific Coast States, where there are now a great number of flourishing trees. Two years ago a serious effort was made to develop the manufacture of camphor from these trees. By improvements in

manufacturing processes, satisfactory results have been accomplished and a large manufacturing concern which uses £100,000 worth of camphor yearly is now making a camphor plantation of 2,000 acres in Florida, from which it hopes to make its camphor.

It will thus be seen that in many countries the production of camphor is receiving attention. This being so, it is not surprising that some journals have recently been deprecating the fact that the Indian Forest Department has not paid more attention to its cultivation. They are probably unaware that the process for making synthetic camphor has been disc overed.* At first the expense of the process prevented artificial camphor from competing with the natural product, but it was fairly certain, for some time past, that a cheaper process would be discovered. Success has now been definitely attained and it turns out that the chief ingredient for synthetic camphor is turpentine, to which the Indian Forest Department have devoted a good deal of attention. The Naini Tal Division gives at present an outturn of about 15,000 gallons annually. In the past there was some difficulty in disposing of the turpentine, but now the market for the latter is brisk and within a few years the outturn from this division will be doubled. If the extensive pine areas of the civil forests in Kumaon could be protected from fire, a large outturn of turpentine could be obtained from them. A small amount of turpentine is also produced in the Jaunsar Division and this could be largely increased. The State of Tehri Garhwal could also yield a good quantity. In the Punjab the industry was started, and kept going for a few years and then closed. The possibilities are great and the present demand will enable the work to be commenced again. Kashmir could yield a large quantity if arrangements were made to protect the pine forests from fire. Burma and Assam too could probably produce large quantities of turpentine from *Pinus Khasya*, so altogether it appears as if the trade in this product could be expanded in India to a very large extent should the demand be an effective one. The fact that the process for making synthetic camphor has been discovered, and that this product can be manufactured at a sufficiently cheap rate to enable

* *Vide* page 63 of Synthetic camphor of this issue.

it to compete with natural camphor, renders the further extension of the cultivation of camphor unlikely—in fact it is probable that it will now fall off in the same way as the cultivation of indigo has done. It is improbable however that natural camphor will be ousted from the market, but prices for both the natural and artificial products will doubtless adjust themselves to a more reasonable scale than at present, much to the benefit of those industries which require camphor for their manufactures.

THE EFFECT OF THE MOON'S PHASES ON THE PERIOD OF FELLING BAMBOOS.

BY A. M. SMITH IN THE ANNALS OF THE ROYAL BOTANIC GARDENS, PERADENIYA, FOR OCTOBER 1907.

In the *Indian Forester* for November, 1906, Mr. E. P. Stebbing, in a paper on "The Effect of the Moon's Phases on the Period of Felling Bamboos," calls attention to a belief apparently very widespread in India that the time of full moon is to be avoided in felling bamboos. This belief extends also to the felling of timber of other sorts, but is apparently not so strongly held in the other cases. The idea is also held in Ceylon, and appears to be a commonplace in forest practice in Columbia, South America (see paper by E. R. Woakes before American Institute of Mining Engineers), being there applied to all timber. It is necessary before dismissing such a widespread belief as a superstition to attempt to find some scientific explanation for it, and work which the writer has recently done on the Growth of Giant Bamboos may perhaps afford a clue to whatever basis of truth lies below the idea.

The native foresters themselves attribute the supposed effect to the greater or smaller quantity of sap present in the stems at the time of felling. It is, they say, more abundant at full moon, and therefore this time should be avoided. The evil effects of felling when full of sap have reference to the attacks of boring beetles (*Dinoderus pilifrons* and *D. minutus*), which are supposed to live

largely on the sap, and therefore the attacks of the beetle are more extensive if the bamboos are felled when full of sap.

Experiments have been carried out in South India to test the theory of the effect of the moon's phases. These have been complicated by the fact that certain remedial measures have been undertaken at the same time, *viz.*, prolonged soaking in water immediately after felling and also covering the felled bamboos from the light. There has not been therefore any decisive test of the effect of the moon's phases, but, as far as it can be ascertained, they lend no support to the native supposition. We have therefore no well-attested facts in support of the idea, and there is really therefore nothing to be explained by any facts known to science respecting the bamboo. It may, however, be worth while for me to indicate along what lines a connection between known facts and the native supposition may be expected, if on any, and also to provide a tentative explanation of certain facts which seem to be the outcome of the experiments in South India. The amount of water present in the culms, whether mature or growing, of the giant bamboo depends largely on the humidity of the atmosphere, *and to some extent on the intensity of light also. Thus, at night* at Peradeniya, when the light is very feeble and the humidity of the atmosphere very high, the adult culms are full of water which rapidly oozes out in drops when any injury is made, such as knocking a nail into the culm. At this time also the young growing culms are so saturated with water that this oozes out spontaneously from the tips and axils of the bracts of the sheathing leaves. The supply of water is no doubt due to the activity of the root system which forces by root pressure a copious supply in the culms above, whether adult or immature. Now, in the daytime this supply is required to replace the rapid loss from the extensive leaf system of the adult culms. It happens therefore that there is a rapid transpiration current along the adult culms and the water is removed as fast as it is supplied from the roots. To be strictly accurate in fact, the upward suction of the leaf system combines with the root pressure to produce a current of water more rapid than would be the result of root pressure alone. Not only does the

loss of water from the leaves produce a rapid transpiration current in the adult culms, but it also appropriates the supply for the growing culms which are on the same rhizome system.

The bamboo culms, whether mature or growing, all rise from a complicated network of underground rhizomes, in which the food for the young bamboo is stored. Since a young culm is on the same rhizome as several mature ones, they all have a common source of water supply in the roots below, and the water obtained by the young bamboo, which has no leaf system of its own to suck up the water, depends largely on the amount left over when the adult culms have been satisfied.

The growing culms in fact are left with so small a supply of water in the daytime that not only is there no oozing out of water from them, but the supply necessary for their growth is removed, and their growth is slower or altogether stopped.

Should rain occur during the day, with its accompanying high humidity, the loss from the leaves is checked, a supply of water is available for the young culms, and their growth immediately increases in rapidity. It is not as a rule until darkness sets in that the loss of water from the leaf system is completely checked, and on dark nights of high humidity we get conditions in which the supply from the roots, not being required by the leaves, oozes out from the young culms, and so fills the mature ones that if injured in any spot water flows fairly copiously from them.

It seems to follow, therefore, that if any difference in beetle-resisting qualities occurs in the bamboos at different times of the day or month, it must be due to the greater or smaller quantity of water in the culms when cut down, and this, as we have shown, is a direct consequence of the atmospheric conditions, whether of light or humidity.

If therefore there is really any foundation of fact in the belief of the effect of the moon's phases, it will be probably found to lie in the different weather conditions prevailing at one period of the moon from those prevailing at another. If it could be shown that at full moon in India the atmosphere was either uniformly drier or moister than at new moon, then we should have some clue to a

scientific explanation of the native belief. This point of view brings the native belief into line with the very widespread idea that the moon has an influence on the weather, an idea until recently very prevalent among country-people in England. It is quite likely that the Indian belief may turn out as baseless as the English one.

Leaving the region of conjecture in which there are no certain facts to guide us, we may turn to certain results which have been obtained whilst conducting experiments to test the native belief. These experiments were conducted in such a manner as to leave their interpretation somewhat doubtful. For instance, the following result was obtained on the Nilgiris: "Bamboos cut on dark nights and immediately soaked were not attacked." Here we cannot tell whether the fact of cutting them on dark nights had any part in producing the immunity from attack, or whether the whole effect was due to the subsequent soaking in water. Supposing that the fact of cutting on a dark night has something to do with the effect, some such explanation as the following may perhaps hold good. A dark night is usually one of high humidity, and a moonlight night is probably of lower humidity. This may especially be the case in India, where humidity is often much lower at night than in Ceylon. This being the case, the bamboos cut on dark nights would probably be full of water when cut: whereas those cut on a bright night may have contained less. Hence the mere fact of cutting on a dark night may be partially equivalent to the soaking in water, which has been found a fairly good remedy against attacks. Mr. Stebbing states further on, that those felled on moonlight nights were more severely attacked than those felled on dark ones. No statement is made as to whether these bamboos were soaked or not, but if not the result shows that some difference does occur between those felled on moonlight nights and those felled on dark ones. The explanation I would apply to this case is the same as that for the previous one.

It is much easier to apply some rational explanation to cases such as the above in which a difference is observed between culms felled in the day and those during the night, or between culms felled on dark and those on moonlight nights than it is to suggest

a reason for the supposition that any difference occurs between those cut in the ordinary way, which is, I presume, in the daytime, at different times of the month.

Turning to another point in Mr. Stebbing's paper there seems to be considerable doubt as to which explanation of the relation between the sap and the beetles is correct. Two are given :—

(1) That an abundance of sap hinders the beetles in their boring and tends to drown them out.

(2) That the beetles feed on the sap and therefore attack more readily when abundance of sap provides a good supply of food.

It will be seen that the two explanations are contradictory and cannot both be true. The former falls into line with the efficacy of soaking the bamboos in water. There seems to be good evidence that this precaution is of considerable value. If my explanation of the effect of cutting on dark, as contrasted with moonlight, nights be true, then they also would fall into line with this idea. For when the bamboos are felled on dark nights they are full of what is largely pure water containing certain salts, and the sap present is much more watery than when the bamboo culm is drier during the day. Thus any effect of this sort would be explained on the drowning out theory. When we distinguish between an abundance of sap and an abundance of food material in the sap, we may get the above effect also explained on the second theory, for though sap is more abundant on dark nights and it might seem that food for the attacking beetles would be more abundant, yet it must be remembered that the sap is more dilute on dark nights, and though more abundant may possibly contain less organic food for the insects. Thus the comparative immunity may be due to the fact that not only does the large amount of sap tend to hinder the beetles in burrowing, but also the food supply in the sap may be smaller as it is more dilute.

I cannot give any reconciliation between this view and that which supposses that when the moon is full the bamboos contain more sap and therefore that time should be avoided for felling since the fermenting sap forms an attractive food supply for the

beetles. In the few cases in which we have definite facts to go upon, the bamboos seem more immune from attack when felled full of sap, and for this fact certain explanations can be put forward, as indicated above. It is quite likely therefore that the supposition that the time when they are full of sap is unfavourable for felling may turn out to be quite groundless, and as yet there are certainly no facts brought forward to support it.

To settle the whole question, felling should be done at different times of the day and night, notes being taken of the humidity of the atmosphere and the state of the light. A series of observations might be made to show whether any particular sort of weather, whether dry or moist, is associated at all constantly with full moon in India. Above all, the experiments should be arranged so that they are not complicated by other factors, *e. g.*, soaking, for then we cannot tell to which cause to ascribe a particular effect.

ORIGINAL ARTICLES.

REGENERATION IN THE FORESTS OF THE GODHRA RANGE, PANCH MAHALS, AFTER THE DROUGHT OF 1899-1900.

In the number of this magazine for October 1906, I tried to show the far-reaching havoc caused by the drought of 1899-1900 in the forests of the Godhra Range. I shall now try to give an idea of the effect of the drought on the regeneration in the same forests.

As all the dead teak and *injaili* (other than teak) species were removed within the last five years, the forest was opened up to a greater extent than it was before. This opening out caused changes in the soil, owing to a larger amount of light being admitted to it. Not only the soil cover but the substance of the soil itself was changed, because both were exposed in a greater degree to the air, and the temperature of both was raised. At the same time an absorption of the humus took place. Thus, owing to the

drought and to the subsequent removal of dead trees, the physical conditions were changed both as regards the degree of light and the composition of the soil. Dense regeneration resulted throughout the forests, but that of *injaili* seedlings predominated. The cause of this preponderance in the young growth of species other than teak is not far to seek. The teak trees did not get an opportunity to flower, since most of them were killed outright, and those which survived the drought did not seed profusely either during the time of drought or for a year or two afterwards. The *injaili* seeded abundantly throughout, and their seeds accumulated in the soil during the drought. The change in the soil specially suited *dhawda (Anogeissus latifolia)* and *khair (Acacia catechu)* and the seedlings of these are found in most parts of the Range, having to a great extent covered up the blanks caused by the removal of the dead stuff. The rainfall of the last three years (1905—07) being plentiful, the teak trees which were saved seeded luxuriously and numerous teak seedlings are now found making headway amongst the growth of the *injaili* seedlings. These teak seedlings together with the coppice shoots of the damaged teak which were cut back represent a good proportion of the young stock in some places, but it will still take a few years for the teak to become adequately represented throughout the forests of the Range. At present the stock for the most part consists of young growth with a scattering of trees which survived the drought, but constant fires do great damage, and if they are not prevented the forest will not for a long time attain its former growth. No doubt some of the species like *timru (Diospyros melanoxylon)*, *rohin (Soymida febrifuga)*, *aladi (Morinda excerta)*, *sadad (Terminalia tomentosa)*, and *dhawda* to some extent resist fires; but teak seedlings, which are specially required to form a proper mixture, are killed even by light fires; in fact fires are the chief cause of the restricted growth of teak in the Godhra Range.

These forests are situated on level ground with grass growing high and dense in many parts; fires spread very rapidly and often burn hundreds of acres before they can be extinguished. In order to prevent fires spreading through the whole forest, permanent fire

lines about 200 feet broad were cleared of all growth, but these were found ineffectual to save the greater portion of the forests from fire. It is an extremely difficult task to protect the whole area, and hence in 1902 a plan was devised to give special attention to the protection of the closed portions of the forests. Particular attention has since then been paid to these specially protected areas which, as a result of five years' protection, are now covered with innumerable seedlings of various species. Some additions are made every year to these areas, and it is hoped that thorough protection from fire will eventually bring the whole forest to its former condition.

GODHRA:
5*th December* 1907.

AMBALAL K. DESAI,
Forest Ranger, Godhra.

NOTES ON SANDAL.

LOSS IN WEIGHT OF SANDAL WOOD BY SEASONING.

Like all other woods, sandal heartwood loses in weight by seasoning, but unlike the former which are generally sold by volume, it is sold by weight. It is therefore of some practical importance to determine accurately what loss it sustains during a given period after its felling. The decrease in weight being due chiefly, if not entirely, to the evaporation of the moisture in the wood, the amount of loss is dependent upon various local factors such as temperature, humidity, season of felling, age of the tree, the manner of storing, etc. It is obvious therefore that the percentage of loss by this cause is not the same in all localities and that it should be determined separately for each sandal tract or district by local experiments.

As no information on this subject appears to be available in the existing literature on sandal wood, the following facts and figures collected in the North Salem District some years ago may interest some of the readers of the *Indian Forester* and perhaps may also induce officers in charge of sandal tracts to make more careful experiments in South India and to publish their results.

In the year 1903-04, a number of mature green sandal trees were felled on the Javadi hills. The scented heartwood in the trunks,

Serial number of trees.	Description of heartwood.	Date of felling of trees.	Weighment of roughly dressed heartwood.			Date of final cleaning.	Weight of chips and shavings.
			First weighment on 1-12-03.	Second weighment on 10-1-04.	Decrease in weight.		
1	2	3	4	5	6	7	8
			lbs.	lbs.	lbs.		lbs.
1	Trunk wood ...		434	425	9		36
	Branch wood ...		155	140	15		14
2	Trunk wood ...		483	476	7		7
	Branch wood ...		191	175	16		21
3	Trunk wood ...		271	244	27		4
	Branch wood ...		85½	80	5½		10
	Root wood ...	30th November 1903.	103	98	5	11th January 1904.	19
4	Trunk wood ...		438	419	19		20
	Branch wood ...		19	14	5		2
	Root wood ...		50½	44½	6		2½
5	Trunk wood ...		320	302	18		29
	Branch wood ...		8	7½	½		½
6	Trunk wood ...		224	217½	6½		14½
	Branch wood ...		43½	37	6½		2
	Root wood ...		42	36½	5½		4½

According to this statement, the percentage of loss varied in trunk wood from 11·2 to 21·4, in branch wood from 20·2 to 41·1 and in root wood from 19 to 25·3 during a period of 111 days—between 30th November 1903 *on which the trees were felled and 21st March*

branches and roots of six of the trees felled was separately weighed, and the results were recorded as shown in the following table :—

WEIGHMENTS OF FINALLY CLEANED WOOD.						Grand Total of decrease, cols. 6 + 14.	Percentage of loss after deducting figures in col. 8 from those in col. 4.
First weighment on 12-1-14.	Second weighment on 30-1-04.	Third weighment on 11-2-04.	Fourth weighment on 29-2-04.	Fifth weighment on 21-3-04.	Total decrease.		
9	10	11	12	13	14	15	16
lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
389	373	368	359	346	43	52	13·0
126	117	112	111½	105½	21½	36½	25·8
469	414	403	392	374	95	102	21·4
154	145	140	136	130	24	40	23·5
240	237	233	228½	220	20	47	17·6
70	66	63½	62	60	10	15½	20·2
79	76	74	72	68	11	16	19·0
399	384	375	364	355	44	63	15·1
12	11	11	11	10	2	7	41·1
42	40	39	37	36	6	12	25·0
273	267	260	252	241	32	50	17·1
7	6½	6	5½	5	2	2½	33·3
203	201	197	192½	186	17	23½	11·2
35	34	33½	32½	31	4	10½	25·5
32	31	30	29½	28	4	9½	25·3

1904 on which the last final weighment was taken. The variation in the loss by seasoning of branchwood is very great ; as it is only in *two* out of the *six* trees that it exceeded 26 per cent it would be nearer to accuracy to take 26 per cent as the maximum loss. The

average loss in the trunk wood and branch wood of all the six trees and in the root wood of three trees was 16·3, 24·6 and 22·1 per cent respectively. Comparing the losses between the several weighments given in the preceding table, we find that in *three* trees the largest loss by seasoning in the trunk wood and branch wood occurred between the first and second weighments of the finally cleaned wood in January while the next largest loss was between the fourth and fifth weighments in March, whereas in the other three trees the results were exactly the reverse in respect of trunk wood, and there was hardly any appreciable difference in the case of their branch wood. The comparatively smaller loss in weight in the roughly dressed wood during the first 40 days after felling was probably due to the winter cold on the hills in December, during which the evaporation of moisture in the wood was slower and smaller than during the subsequent months.

It is to be regretted that the experiment of weighing the wood at regular intervals could not be continued over a longer period, owing to the exigency of collecting the budgetted revenue for the year. No reliable conclusions can be drawn from the results of this single and incomplete experiment; but the figures may perhaps serve as a very rough working guide, till more accurate and scientific data are collected by a series of systematic experiments.

The writer is indebted to Khan Sahib Syed Burhanuddin Sahib, now the District Forest Officer of North Cuddappah for the collection of the figures in the foregoing table, while he was supervising the exploitation of sandal wood in 1903-04.

That an appreciably large loss by seasoning continues to occur in sandal heartwood, even long after it is felled and prepared for the market, is proved by the figures collected by the writer in the Salem district between 1896 and 1901, and recorded in Table II on page 21. The figures in column 10 of this table do not represent the entire loss in weight between the dates of felling and final weighment at time of delivery to purchaser, but they indicate only the percentages of loss between the first weighment which took place months after the felling and conversion, and the final weighment. In these cases, considerable loss by seasoning must have

occurred between the time of felling and that of the first weighment, judging from the figures recorded in the Table on pages 18-19.

Table II.

Serial No. of lot.	Description of wood.	When felled.	First Weighment. Date.	First Weighment. Weight in lbs.	Second Weighment. Date.	Second Weighment. Weight in lbs.	Difference between cols. 5 and 7.	Percentage of loss in weight.
							lbs.	
1	Billet wood ...	Octr. 1896 to Feb. '97.	Feb. '97	29,700	18-8-'97	26,710	2,990	10·0
2	Root ,, ...	Ditto.	Ditto.	3,525	Ditto.	3,103	422	12·0
3	Stem ,, ...	Feb. '97.	28-2-'97	775	2-9-'97	688	87	11·2
4	Root ,, ...	Felled in latter part of 1894-95 and root dug out between Decr. '95 and Feb. '96.	Between 20-1-'96 and 27-2-'96.	8,097	6-4-'96	7,525	572	7·0
5	Billet ,, ...	March to June 1900.	5-2-'01	9,886	6-5-'01	9,132	754	7·6
6	Root ,, ...	Ditto.	Ditto.	1,794	Ditto.	1,717	77	4·3
7	Billet ,, ...	Octr. and Novr. 1898.	Decr. '98	8,109	13-4-'99	7,375	734	8·3

Bangalore :
17th December 1907.

M. Rama Rao,
Extra Deputy Conservator of Forests.

THE FOREST DEPARTMENT AND THE LIST OF HONOURS.

(CONTRIBUTED.)

The question has often been put to us as to why the name of a Gazetted Forest Officer so seldom finds a place in the list of Honours, and we rather wonder why this question has never been brought to the front in the pages of the *Indian Forester*.

As far as we can remember, though we may be wrong, the only Forest Officers who have been deemed worthy of a special

recognition at the hands of Government have been Inspectors General towards the end of their service and a Director of the Forest School on his retirement. We are inclined to think that when an honour, such as C.I.E., is given towards the close of a man's service, this somewhat detracts from its value. It is not of much benefit to a man leaving India, it does not help him in England nor does it receive much recognition there from the vulgar crowd. We know of a case in which an Officer (not of the Forest Department), after being included in the list of Indian Honours, went home to see what was the value of his decoration in the business or official world, in other words to see if it would be of any use to him in finding some employment for his maturer years. He returned to India a disappointed man. We have further heard a distinguished Officer say that if offered some decoration on his retirement, he would beg leave to decline, whereas, if he had been accorded this distinction some years previously he would have welcomed it and felt the full value of what was virtually admitting him to be a marked man in his Department. Doubtless the full worth of the best Forest Officer's service is generally not immediately evident, probably it will be not fully recognised for some decades after he has left the country by any but the men in and especially at the head of his Department. In this respect his work differs from that of an eminent Engineer, military man or member of the Civil Service ; it therefore probably does not occur to any one that he should be singled out in any special manner, in fact, the powers that be, may, and not unnaturally so, be unaware that his services have been anything much out of the common; if at the top of the tree on his retirement he may receive some recognition, too late, however, to appeal to him.

"*Bis dat qui cito dat.*" If his services had been rewarded earlier, in other words if it had been brought to the notice of Government that he should be singled out as a specially good man before he rose to the higher administrative posts, the officers under him would at once recognise and appreciate the confidence reposed in him, owing to which his work would be easier, his power for good all the greater, and the forest progress in his province the

more rapid, while the Department at large would feel that it had not been overlooked and would be grateful for the honour done to one of its members. There is no doubt that Local Governments must find it difficult to recommend a Forest Officer for special recognition, all the more so as on his reaching an administrative post he is often transferred to a province entirely new, and has to deal with officials who have never heard of him; he may again be transferred to another province before perhaps he has felt his feet in the province that he is leaving. This is no doubt a difficulty that has to be got over, but perhaps it is not insuperable.

Now that the importance of the Department has been more fully recognised as shown by the recent reorganisation of the Imperial Service, we believe that the occasional inclusion in the list of Honours of some member of it, shall we say a C.I.E. given to the Imperial Service, would emphasise the fact that its work is, though often without any immediate apparent result understood and appreciated by the custodians of the Empire.

It was remarked a short time since, that though no Indian decoration had been conferred on Forest Officers for some years, and this very possibly because attention had not been specially invited to the work of the Department, the Royal Society numbered amongst its fellows a greater percentage of Forest Department men based on the total strength of the Imperial Service than of any other Department in India, and this recognition on the part of the Royal Society of the Department then smarting under the feeling, rightly or wrongly, that it was not being estimated at its proper value was all the more highly appreciated inasmuch as it emanated from the most exclusive Scientific Society in the world.

Foreign Governments have also been more liberal in their recognition of merit than the Indian Government, and we note with somewhat mixed feelings after perusing the classified list, that the only decoration shown against an Imperial Service Officer's name is one given by a Foreign Government.

[This article was received in December. The recent bestowal of a C. I. E. on the Inspector-General of Forests supports the arguments of our contributor.—HON. ED.

REVIEWS AND TRANSLATIONS.

WORKING PLAN FOR THE ARDROSS WOODS (ROSS-SHIRE) FOR 1908—1927.

BY W. SCHLICH, PH.D., C.I.E., F.R.S., I.F.S. (RETIRED) AND R. S. PEARSON, I.F.S., F.L.S.

Through the courtesy of Dr. Schlich, we have received a copy of this Working Plan for the Ardross Woods, in Ross-Shire. The property belongs to C. W. D. Perrins, Esq., of Ardross Castle. The owner wishing to place the woodlands under proper and systematic management, invited Dr. Schlich to prepare a Working Plan for them. The woods consist of 4,424 acres, but of these 336 acres were kept aside as Policy woods in accordance with Mr. Perrins' desire and were not included in the Working Plan. Of the remainder, 269 acres, being above 1,000 feet elevation, are unproductive, leaving 3,819 acres to be dealt with under the Working Plan.

The estate is in Ross-Shire at a latitude of 57½°. It is situated in the valley of the River Alness; the lower part of the estate extending down to Alness Station, within one mile of the Cromarty Firth. The underlying rocks are (1) old red sandstone, shales and conglomerates and (2) metamorphic schists. Roughly two-thirds of the woods are on (1) and the remainder on (2).

The soil, generally speaking, may be said to consist of a layer of humus, of varying thickness, followed either by a sandy gravel, or a loam, or a peaty loam, or brown clay, below which is generally found a yellow or grey sand, more or less gravelly. In some places the rock outcrops. A portion of the soil is wet and requires draining. The climate is rather cold and moist.

The woods are divided into 14 blocks, which have been retained to avoid confusion at the outset.

The principal species are Scotch pine and larch and next to these spruce. The authors have classified the crop into three

quality classes (in the way that all Dr. Schlich's pupils will remember well), with the following result :—

I Quality, best productive	...	...	... 1,696	acres.
II „ middling „ ...	...	...	... 1,422	„
III „ lowest „ ...	...	...	... 701	„
	Total productive		... 3,819	„

The present distribution of age classes is very unfavourable, *viz.*:—

Woods	1 to 20 years old =	212 acres	=	6 %	of the total area.	
„	21 to 40 „ „ =	162 „	=	4 %	„	„
„	41 to 60 „ „ =	3,320 „	=	87 %	„	„
„	over 60 (70) „ „ =	125 „	=	3 %	„	„
		3,819		100		

The system of management adopted is clear felling with replanting. The rotation fixed upon is 80 years, which experience, in the case of woods like those under consideration, has shown to be the age insuring the best financial results. The present woods will, therefore, all be cut over and replanted in the course of eighty years. This gives a mean area for felling annually equal to $\frac{3819}{80}$ =48 acres, or 960 acres during the first 20 years. As, however, the present age classes are so irregular, it has been necessary to take in hand 1,335 acres in the first 20 years. The areas comprising this acreage were selected as requiring earlier attention than others. After 20 years woods from 1 to 40 years in age will amount to 41 per cent and from 41 to 80 years 59 per cent of the whole area against the present 10 per cent to 90 per cent respectively. A new allotment can then be made so that gradually a regular series of age-classes will be introduced, leading to an equalised sustained yield.

The fellings are arranged in four Cutting Series and the coupe for the first year is in one series, for the second year in another, and so on, so that a number of years will elapse after each felling before a second felling is made adjacent to the former.

The financial results for the past five years gave an average net income of £331 per annum. The Working Plan forecasts an average surplus of £1,000 per annum during the first 20 years,

while the authors state that eventually it is likely that an annual net income of £3,000 will be attained.

It is difficult to do justice to this concise Working Plan in a short notice—such operations as thinnings, re-stocking of the cleared areas, draining, maintenance of nursery and construction of roads are all provided for. The work will give permanent employment to two foresters at £ 80 per annum each, and to thirty labourers at 18-*s* a week.

The Plan is neatly got up with an Index Map on the scale of 1″ = 1 mile and is printed by Bradbury, Agnew & Co. Two other maps were prepared by Mr. Pearson, one showing the quality classes of the soil and the other indicating the age-classes of the woods, both of them on the scale of six inches to one mile.

The Appendices give—I, a table showing the area of the quality classes in each block—II, a statement giving the areas under the different age-classes by blocks—III, full descriptions of each block—the boundaries, configuration, soil, quality classes, growing stock and future treatment, all being described in detail—and IV, the form for the upkeep of the control book.

Systematic forest management is now showing signs of being taken up seriously in many parts of Great Britain, chiefly through the untiring efforts of Dr. Schlich, to whom the country is greatly indebted. We trust that many other proprietors will follow the example of the enlightened owner of Ardross and have suitable Working Plans drawn up for their woods, in order to bring them under systematic management.

CURRENT LITERATURE.

MEMOIRS OF THE INDIAN MUSEUM, VOL. I, NO. 1 (*Text and Plates*).—We have received No. 1 of the newly-instituted Memoirs containing a comprehensive account of the Rats of Calcutta by W. C. Hossack, M.D., Plague Department, Calcutta. It is accompanied by eight excellent plates issued in a part separately from the text; this is a most convenient arrangement since the plates can be readily referred to while the text is being read. A pamphlet entitled "Aids to the Identification of Rats connected with Plague in India, with suggestions as to the Collection of Specimens" by the same author is distributed with the above Memoir.

RECORDS OF THE INDIAN MUSEUM, VOL. I, PARTS I TO III, JUNE, AUGUST AND OCTOBER 1907.—These parts commence the new Journal of Indian Zoology published by the Trustees of the Indian Museum. The three parts contain some twenty-two papers on Zoology, most of them are of too scientific a character to notice here in detail. Each part finishes with many interesting notes on diverse subjects under the head "Miscellanea." The Journal will fill a long-felt want and Zoologists throughout the world will welcome this publication.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA, VOL. II, NO. 2, SEPTEMBER 1907.—This number contains a monograph by G. A. Gammie, F. L. S., on the Indian Cottons. The nine species (*Gossypium : obtusifolium, arboreum, sanguineum, herbaceum, intermedium, indicum, neglectum, cernuum* and *hirsutum*) are all dealt with. The author describes fifteen new varieties of these species and seven new sub-varieties. The text is illustrated

by fourteen magnificent plates in colour, drawn by R. K. Bhide (*Thacker, Spink and Co., Price Rs.* 7-8-0.)

FORESTRY AND IRRIGATION FOR NOVEMBER, 1907.—The issue opens with the usual editorial. The most important subject of this is the Wood Famine. The editor says: "The famine is no longer an object of future dread: it is here." It is further remarked that "Some persons place all their hope of relief from high prices of lumber on supplies from other countries, particularly Canada. However desirable it may be to get lumber from Canada and thereby save our own trees, still such relief can be but temporary. It is imperative that we take care of our own timber crops and not stop with coveting those of our neighbours. It is not merely a question of present prices but of guarding against having no supply at any price." "It is very much to be hoped that the Canadians will not allow us to cut their timber without regulation, however eager we may be to buy it."

Twelve pages of notes on many subjects follow. Among the news given is that the Chinese are about to open their first school of forestry, it is to be at Mukden. Other papers deal with "The President's Journey on the Mississipi," the "State Investigation of Michigan Forest Situation" and "Prairie Homes and Forest Trees." "Work in a National Forest" by C. H. Shinn is continued, this being "No. 4. Sheep in the High Sierras." The latter is one of a series of most interesting articles, which are well worthy of the attention of Indian Foresters.

THE BOTANICAL GAZETTE FOR NOVEMBER 1907.—Besides several scientific papers on Botany this number contains an extremely interesting article on "The Forest Formations of Boulder County," Colorado, by Robert T. Young (with twelve photographs). The author considers a "Formation" as a group of plants of definite composition as to species occupying a definite habitat as to the physical characteristics of the latter, or a definite area as to geographical position. He classes the forest of the Boulder County under the following: (1) *Populus occidentalis—Salix fluviatilis* formation; (2) *Populus angustifolia—Salix Nuttalli* formation; (3) *Pinus scopulorum* formation; (4) *Pinus Murrayana* formation; (5) *Apinus*

flexilis formation; (6) *Pseudosuga—Picea Engelmanni* formation; and (7) *Picea Engelmanni—Abies lasiocarpa* formation. Each formation is discussed in detail as to the species found, their habits, and the physical conditions.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE CAMPAIGN AGAINST NOXIOUS INSECTS IN AMERICA.

Few persons, other than entomologists, are endowed with any adequate conception of the vast amount of insect life existing on the surface of the globe, or of the preponderance of this over all other forms of animal life. Insects, writes Dr. David Sharp in the *Cambridge Natural History*, out-number in species all the other terrestrial animals together, while compared with vertebrates their numbers are in this respect simply enormous. Nevertheless they attract, as a rule, comparatively little attention, the largest kinds not exceeding a mouse or a wren in point of bodily size, while the smallest are so minute as to be invisible to the unaided eye. This insignificance in individual bulk is, however, more than compensated not only by the enormous number of species by which these creatures are represented, but likewise by the hosts of individuals belonging in many cases to such species. They are undoubtedly the most successful of all forms of terrestrial animals; and in the opinion of the writer just referred to it is probably not too much to affirm that the greater part of the animal matter living at any particular moment on the land surface of the entire globe is embodied in the form of insects. This assertion, moreover, is, we believe, by no means restricted to the particular time in which we are now living; but is intended to embrace the period when the big game fauna of Southern Africa were in its prime. Probably, indeed, the preponderance of insect life is so overwhelming that the loss of a few million elephants, rhinoceroses, and antelopes would scarcely affect the comparison.

It is a truly staggering comparison ; and one which when fully realised makes us wonder how it is that insects have not long since starved out or otherwise eliminated every other kind of living creature and made themselves the lords and masters of the world. That, under certain circumstances, they might render horticulture and agriculture absolutely impossible in many parts of the globe, is quite conceivable ; the ravages of locusts affording a case in point. Insect pests form, indeed, an ever-present danger in the warmer parts of the globe, against which the agriculturist and the fruit grower have to fight with might and main, aided by all the resources of modern science.

Nowhere is this recognized more fully than in America, where owing to the vast range in latitude of cultivated territory, noxious insects have a better chance of inordinate increase and multiplication than almost anywhere else in the world. A bureau of entomology, forming a section of the department of agriculture has been established for the whole of the United States, and is now in full working order ; while similar institutions have been organised in the Philippines and in Hawaii. These boards have apparently the power of recommending the enactment of such legislature as seems to them necessary ; while they are entrusted with the task of seeing that the laws already in force are effectually and adequately carried out.

Recently the bureau for the United States has issued a pamphlet in which are recorded the laws in force against injurious insects in the various States of the Union, and the means adopted for the prevention of the introduction and spread of insect pests by nursery stock or seed. The comprehensive nature of these laws and the extreme care now taken to check and circumscribe the ravages of injurious insects throughout the territories under the dominion of the Federal Government will at once be apparent from a perusal of this pamphlet. To give a review of even the general scheme of these enactments would, however, altogether exceed our available limits ; and we must accordingly content ourselves by referring to a few examples of the nature of the work of the bureau.

One of the most dangerous pests is the so-called Mexican cotton boll-weevil; a small beetle which in its larval condition attacks and devours the buds, or "bolls" of growing cotton. Various methods of destruction were tried; but it was at length demonstrated that the best hopes of success lay in an appeal to the efforts of Nature herself. Cotton-buds when pierced by the beak of the adult weevil display, it appears, a tendency to the development of a large quantity of abnormal tissue in which the grubs are hatched and proceed to develop. So great, however, is the amount of this abnormal gelatinous tissue (the production of which is technically known as proliferation) that a considerable proportion of the grubs perish, apparently crushed to death by an excessive supply of the very substance forming their food. It is found that the tendency to proliferation may be stimulated by puncturing the cotton buds; and strains are therefore recommended for cultivation in which this proliferating tendency is most strongly marked. Parasites have also been tried as a means of checking the ravages of the weevil; but it seems already apparent that proliferation is the more potent factor in effecting the destruction, and it is confidently expected that, with human assistance, the plant itself will eventually prove victorious in the struggle against the insect enemy.

Even, however, if these hopes be eventually realised, there appear to be collateral results due to the visitation and spread of the boll-weevil. Owing to its ravages, cotton cultivation in Texas has entered upon a new phase, in consequence of which various harmful insects which were formerly ignored have assumed, as the results of earlier and more speedy cultivation, much greater importance than formerly. Further investigations are still necessary, but according to present information it is considered that these minor pests can be most effectually dealt with by yet further improvements in cultivation rather than by recourse to poisons.

Another instance of an expected victory over an insect-pest is afforded by the case of the San Jose, or rather the Chinese, scale insect (*Aspidiotus perniciosus*), a member of that baleful family the *Coccidæ*. This insect first made its appearance during the early seventies in orchards in the San Jose Valley, California; and soon

increased to such an alarming extent in the neighbouring territories as to give rise to serious fears as to whether fruit-growing would not become an impossibility in many districts. All portions of the trees attacked became infested with the tightly adhering scales under the protection of which the insects develop; and a large number of well established trees soon succumbed outright to the attacks of the pest. Along the Pacific Coast planters and orchard-growers beheld with dismay the gradual but steady advance of the insidious enemy; and by the early nineties the pests had spread to British Columbia in the one direction and to New Mexico in the other, while, as the result of importation of nursery stock the rich orchards of Virginia likewise came within its range. Reports were current that the original home of the pests were Japan; but as the result of a special expedition despatched by the United States Government, it was eventually ascertained that the insect had been introduced into the Japanese islands from the Asiatic mainland, and that its native habitat was a remote district in north-eastern China, where isolation from the outer world had for centuries prevented its diffusion.

No sooner was its true location determined than efforts were made to ascertain the native enemies of the scale insect, in the hope that by the introduction of the most efficient of these into the United States the ravages of the plague might be effectually stayed. Strong hopes were at first concentrated on the introduction of the small Asiatic ladybird known as *Chilocorus similis*, a species closely akin to one indigenous to the United States, but differing markedly in the colouring of the larva, which is pinkish, with black spines, instead of grey. Moreover, the Asiatic species gives rise to four or five annual generations, instead of but one or two, thus being a much more potent enemy, as it is the larva, of course, which feed upon the scale insects. Although in many places unsuccessful, in Georgia an imported colony of Asiatic ladybirds throve, for a time at least, to a wonderful extent, and did vigorous execution on the pest. In other localities, however, where various chemical washes were being tried with success, the ladybirds tended to disappear from the destruction of their natural food supply, and by the action of an

indigenous parasite, which began to attack it a year after its introduction. In Washington, indeed, the parasite practically wiped out the ladybird colony, but in the case of the more Southern colonies the attacks were less effective.

On the other hand, native American parasites have begun to turn their attention on the intruders; and it is considered probable that ere long many of the indigenous predaceous beetles also will join in the work of extermination; "and undoubtedly as years go on the seriousness of the San Jose scale infestation will diminish, as in fact it has already done in California and perhaps noticeably also in some sections of the eastern states."

The greatest success has, however, attended treatment with a lime-sulphur wash (originally prepared as a sheep-dip), and the pest is now considered to be so much under control that the fear of fruit-growing having to be altogether abandoned in certain districts are now rapidly subsiding. Incidental advantages have likewise attended the use of this wash, which is found to be of great value as a fungicide, so that its use is recommended even in orchards which are free from attack by the scale-insect. Nor is this all, for in order to combat the pest, greater care has been exercised in the selection, planting, pruning, and general cultivation of young trees (more especially peaches, which are those, which suffer most from the pest), with the result that great benefits have accrued to the fruit-growing industry as a whole. Possibly therefore the invasion of the Chinese scale-insect, which at first threatened the most disastrous results, may eventually prove to have been a blessing in disguise.

Our last instance relates to Hawaii, where the sugar planters in 1900 were alarmed by the appearance in numbers in their plantations of an insect allied to the cicadas and commonly known as the cane leaf-hopper, but scientifically termed *Perkinsiella saccharicida*. Since then the pest has increased enormously, causing a loss of millions of dollars to the planters. The leaf-hopper has, however, a number of enemies among the insects indigenous to Hawaii; and had it not been for the extent to which it was held in check by their attacks, it is probable that sugar-growing would have

become impossible. Nevertheless, these indigenous enemies were unable to cope with the swarms of leaf-hoppers, and it became clear that unless other means of diminishing its numbers were discovered, the sugar-industry of the Sandwich Islands would be ruined. Accordingly, the Entomological Division of the Planters' Association at Honolulu endeavoured to find an efficient remedy. It was soon decided that such a remedy would most likely be discovered in insects capable of preying upon the leaf-hoppers with greater vigour than any Hawaiian species; and in 1903 and the two following years expeditions were despatched to North America, Australia, and Fiji for the purpose of discovering such insects.

After a few preliminary experiments, the choice was soon narrowed to certain minute Hymenoptera which feed upon the eggs of leaf-hoppers, namely, to species of the genera *Anagrus*, *Paranagrus*, and *Ootetrastichus*. The members of the two first genera complete their life-cycles in about three weeks, breeding at about the same rate throughout the year, and being largely parthenogenetic. *Ootetrastichus* on the other hand, takes fully twice as long to complete its cycle, but produces twice as many eggs, and is entirely parthenogenetic. Other things being equal, the product of the former genera at the end of six months will, however, be a million times more numerous than those of the other genus. On the other hand, the latter is not only more hardy, but has the advantage that each individual is bred at the expense of the entire contents of the egg-chamber of the leaf-hopper instead of destroying only a single egg. Of the four species introduced, one *Paranagrus* is at present the most effective, but the *Ootetrastichus* is slowly increasing in numbers, and is expected to prove the most effective in the end.

As already indicated the foregoing are only a few out of many instances of more or less successful crusades waged by the entomological bureau of America and kindred institutions in its dependencies against insect foes; but the whole record of these organisations is highly creditable and affords an object lesson to other countries.—*The Indian Field.*

EXTRACTS FROM OFFICIAL PAPERS.

THE HALF-YEARLY CLASSIFIED LIST OF FOREST OFFICERS IN THE THREE PRESIDENCIES TO BE DISCONTINUED.

Government of India's Circular No. 28-F., dated 17th August 1907, to all Local Governments and Administrations.

The Government of India, having had under consideration the question of the issue of the half-yearly "Classified List of the Forest Officers in the three Presidencies," have arrived at the conclusion that, as all information which is required in the Department of Revenue and Agriculture is obtainable from the Provincial Civil Quarterly Lists and Government Gazettes, the publication of the half-yearly classified list may in future be discontinued.

2. I am directed therefore to say that this Department's Circular No. 14-F., dated the 19th October 1904, may be considered cancelled, and that the Provincial classified lists need no longer be forwarded either to this Department or to the Superintendent of Government Printing, India.

3. Article 73 of the Forest Department Code will also be cancelled, and the information therein called for need no longer be supplied, save in those cases where the terms of other articles of the Code render this necessary.

4. The "General List" of Forest Officers for the Bengal Presidency and the "India List" of Forest Officers appointed by the Government of India will, as heretofore, be issued half-yearly and forwarded to Local Governments for information and distribution.

REVISED RATES OF DAILY TRAVELLING ALLOWANCE FOR ASSISTANT AND EXTRA ASSISTANT CONSERVATORS WHEN PLACED IN CHARGE OF DIVISIONS.

Government of India's Circular No. 40/415-1-*F., dated the* 23*rd November* 1907, *to all Local Governments and Administrations (except Bombay).*

The Government of India have recently had under their consideration the question of revising the daily rates of travelling

allowances at present admissible to Assistant and Extra Assistant Conservators of Forests under Article 1063 (i) and appendix 25 of the Civil Service Regulations.

2. Under the graded system of pay, which has recently been abolished, it frequently happened that an Assistant Conservator officiated as a Deputy Conservator for short periods in the 3rd, 4th and 5th year of his service, thus becoming entitled to draw the higher rate of travelling allowance admissible to Deputy Conservators. With the introduction of the new time-scale system of pay an Assistant Conservator does not enter the class of Deputy Conservators till the 6th year of his service; so that in the matter of travelling allowance he is in a less favourable position than he was before.

3. In order that the existing rates of travelling allowance admissible to Assistant Conservators may be adopted to the altered circumstances under the new time-scale of pay, the Government of India are pleased to direct that an Assistant Conservator, when in charge of a Forest Division, will be entitled to draw travelling allowance at the rate admissible under the rules to Deputy Conservators.

4. They further direct that an Extra Assistant Conservator placed in charge of a Forest Division will similarly be entitled to draw travelling allowance at the rate at present admissible to Extra Deputy Conservators.

5. The necessary amendments to appendix 25 of the Civil Service Regulations will issue in due course.

THE WANING HARDWOOD SUPPLY OF THE UNITED STATES.

BY WILLIAM L. HALL.

The hardwood lumber cut in 1899, according to the census, was 8,634,021 thousand feet; in 1906 it had fallen to 7,315,491 thousand feet, a decrease of 15·3 per cent.

This decrease took place during a period when American industries sprang forward at a pace unparalleled; when there was the strongest demand ever known for every class of structural material; when the output of pig iron increased 15 per cent, that of cement 132·17 per cent, and even that of softwood timber 15·6 per cent.

That the decrease is due to diminished supply rather than to lessened demand seems to be proved beyond question. During the same period the wholesale price of various classes of hardwood lumber advanced from 25 to 65 per cent; every kind of hardwood found in quantity sufficient to make it useful has been put on the market, and hardwood timber is now being cut in every State and every locality where it exists in quantity large enough to be cut with profit. These conditions could not prevail were the decrease in production due to a falling off in demand.

The most notable shrinkage has been in the leading hardwoods to which the public has been long accustomed.

Oak, which in 1899 furnished over half the entire output of hardwood lumber, fell off 36·5 per cent. Yellow poplar, which in

1899 was second among hardwoods in quantity produced, fell off 37·9 per cent. Elm, the great standard in slack cooperage, went down 50·8 per cent. Cottonwood and ash, largely used in many industries, lost respectively 36·4 and 20·3 per cent.

The supply in Indiana and Ohio, the original centre of hardwood production, is practically exhausted, and the cut is now widely distributed and is heavy in every State where there are even small bodies of hardwoods.

Together with Illinois, Ohio and Indiana produced 25 per cent of the hardwood in 1899. In 1906 they produced only 14 per cent. They can never regain their lead, or even maintain the standing they have. Their many wood-using establishments, which are now hard pressed for supplies, will exhaust their remaining remnants within a few years. The land which bore this timber, as fast as it was cleared, was turned to agricultural use for which most of it is well suited. The improved farm lands of Indiana increased 10·4 per cent between 1890 and 1900; those of Ohio, 4·9 per cent. In both States there is some waste land which will continue in timber and turn out local supplies, but not enough to have any considerable effect on the country's hardwood supply.

States not thought of in former years for their hardwoods are now turning out considerable quantities. Maine, with a cut of 29 million feet in 1899, went to 73 million in 1906; New Hampshire turned out 60 million in 1906 as against 23 million in 1899. Even Oregon, Montana, and other Western States came into the list with unexpected amounts. In all of the States west of the Mississippi Valley the supply is small, and can never become much of a factor.

The impressive thing is that we are bringing hardwoods from far and near, and still the cut is going down.

The main production is now in the Lake States, especially Michigan and Wisconsin, the lower Mississippi Valley, and the Appalachian Mountains. What are the conditions in these regions?

The three Lake States furnished 18 per cent of the hardwood cut in 1906, as against 16 per cent in 1899. This percentage

increase does not mean a real increase. On the contrary, everyone of the Lake States fell off, though although their cut did not decrease in proportion to that of the rest of the country. The figures seem to indicate unmistakably that their maximum production has been reached. If this is true, then their decline in the future is likely to be almost as rapid as that of Ohio and Indiana, because of the nearness of many large hardwood-using industries which will make heavy demands upon the supply. This is now the supply nearest to many of the great plants in Illinois, Indiana, and Ohio.

The hardwoods in the Lake States stand upon good loam soil which, though stony in places, produces the finest of grasses. Where arable, this soil yields good crops of hay and potatoes, and in some localities grain and fruit. So invariably do the hardwoods indicate good soil that they are one of the most common means of land classification. And since hardwood land always means good soil, land from which hardwoods are cut does not revert to the States, as has been frequently the case with pine land, especially in Michigan. The hardwood land is held until it can be sold to farmers who clear it and turn it permanently to agricultural use, for which, as in Ohio and Indiana, it is fundamentally suited.

The southern part of Michigan, which originally bore magnificent hardwoods, was the first part of the State to be cleared, and is now the backbone of Michigan's agriculture. Just as fast as the hardwoods, even in the northern peninsula, are cut the land will be settled for farming. The same is true of Wisconsin and Minnesota. The almost complete exhaustion of their timber supply and the transformation of their hardwood lands into farms are apparently the only results to be expected.

The States of the lower Mississippi Valley, including Missouri, Arkansas, Texas, Louisiana, and Mississippi, produced in 1899 1,203,914 thousand feet, or 14 per cent of the entire output of hardwood lumber. In 1906 they produced 1,252,604 thousand feet, or 17 per cent of the country's output. The percentage gain, it will be seen, represents a very slight absolute gain ;

Missouri and Texas declined somewhat, while Arkansas, Mississippi and Louisiana made considerable increase. The figures indicate that this group of States has nearly, if not quite, reached its maximum cut. In these States, following the rule already noticed, the hardwoods are found on very fertile soil. They centre in the lowlands—the river bottoms and the swamps. On account of their great fertility these lands are now desired for farming and clearing, and even drainage where necessary, are being hastened in order to turn them to the production of cotton, corn, and other crops. An exception, of course, exists in the Ozark Mountains of Missouri and Arkansas, certain portions of which are better adapted to hardwood timber than to other uses. Such areas are relatively small. In the main, those mountains have a climate and a soil which adapt them to fruit growing, for which the Ozark section has already become noted. In common with the whole lower Mississippi Valley, this region must be expected to change largely from a timbered to an agricultural condition.

The States which are considered to form the Appalachian group are as follows:—Maine, New Hampshire, Vermont, Massachusetts, New York, Pennsylvania, Maryland, West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, and Alabama. They turned out in 1899 3,667,495 thousand feet of hardwood, which was 42 per cent of the total cut. In 1906 they produced 3,546,668 thousand feet, or 48 per cent. They thus increased their proportion 6 per cent, although they actually fell off 121 million feet.

While but small parts of several of these States lie in the mountains, it is true of the region as a whole that the bulk of their hardwood timber is now to be found in the mountains. The Appalachian Mountains must have fully half of the country's present supply of hardwood, in spite of the fact that heavy cutting has been going on in them for over a hundred years.

There are two main reasons why this region has borne such heavy cutting and still contains so much of the supply. In the first place, the mountains are non-agricultural. There has been no wholesale tendency to clear them for farming. Profitable

farming exists, as a rule, only in the valleys and on the lower slopes. Many sporadic attempts have been made to farm the higher mountains, especially in the Southern Appalachians, but the farms have been small and generally unprofitable. After the pioneers' patience or endurance has been exhausted, the forest has slowly crept back and reclaimed the land, from which it never should have been removed.

In the second place, inaccessibility accounts for the continued forest character of the Appalachian region. With the low prices which prevailed until a few years ago, it did not pay to bring the timber down from the higher mountains. So it was allowed to remain.

While other causes may have had local influence, these conditions in the main account for the fact that the Appalachians have maintained their hardwood production. Nevertheless, some of the Appalachian States have gone back badly. Kentucky and Tennessee show heavy declines. In these States the lumbermen have gone farther and farther into the forest, until, even in the most inaccessible parts, little virgin growth remains.

It is only in the extreme portions of the mountains that the cut has held up or increased. Maine, New Hampshire, and Vermont in the North, and North Carolina in the South, show increased cuts. Not one of these States, however, shows anything like the production that Ohio, Indiana, Kentucky, or Tennessee has shown in the past.

The plain truth is that in the Appalachians, as in the other regions, the hardwood lumbermen are working upon the remnants.

In view of existing situation, it is important to consider as closely as possible how long the hardwood supply will last. To reach any conclusion on this point we must know approximately how much hardwood we are using yearly, and we must know or estimate the available supply.

While we know within reasonably close limits how much hardwood is used for the manufacture of lumber, we do not know how much is cut for other purposes. Enormous quantities are required each year for railroad ties, telephone and other poles,

piles, fence posts, and fuel, and a great amount is wasted in lumbering and manufacture. The present lumber cut of 7⅓ billion feet represents probably not one-third of the hardwoods yearly used. Twenty-five billion feet yearly is certainly not a high estimate.

The amount of standing hardwoods is still more uncertain. There has been no census of standing timber, and there have been but few estimates. The largest estimate sets the figure for hardwoods at 400 billion feet. If we are using hardwoods at the rate of 25 billion feet per year, this would mean a sixteen years' supply. The conditions during the past few years suggest no reason for increasing this estimate. A distinct difference exists between the softwood and the hardwood situation. The supply of softwoods east of the Mississippi is running low almost as fast as that of hardwoods. Of softwoods, however, a large supply exists on the Pacific coast, which will suffice for a number of years after the eastern supply is exhausted. There is no hardwood supply in the Far West. When the supply in the Central and Eastern States is gone, there will be no other source to which to turn.

White oak quartered, for instance, \$52 in 1887, sprang up to \$70 in 1900, to \$85 in 1903, and is quoted at \$80 this year.

Considering the impoverished supply and the tremendous demands on the part of all the industries for timber, there is nothing surprising about the increase, which seems not quite to have kept pace with the increasing prices of softwoods. This is rather remarkable in view of the shorter supply, but is probably due to the fact that softwoods, forming the main bulk of the lumber supply, have led in establishing prices.

Along with the increase of prices there has been an almost constant, and an entirely necessary, relaxation of the rules by which lumber is graded and sold. The latest and most significant change is that made by the National Hardwood Lumber Association at its meeting in Atlantic City in May 1907. Heretofore only even lengths, such as 6, 8, and 10 and 12 feet have been upon the market. The changed rules allow even lengths down to 4 feet and 15 per cent of odd lengths above 4 feet. Smaller standards

of thickness are also allowed. Many other equally significant changes are included. It emphasises the fact that we are down to the rock bottom, and require every sound piece of hardwood lumber that can be put upon the market.

The situation in brief is this: We have apparently about a 15 years' supply of hardwood lumber now ready to cut. Of the four great hardwood regions, the Ohio Valley States have been almost completely turned into agricultural States, and the Lake States and the Lower Mississippi Valley are rapidly following their example.—(*Timber Trades Journal.*)

SYNTHETIC CAMPHOR.

FUTURE OF THE NATURAL PRODUCT.

Synthetic camphor is at last an accomplished fact, and a product which is said to respond to all the chemical tests of natural camphor and to answer all its industrial requirements can now be obtained in England in commercial quantities at prices materially below the present cost of the natural article. Until a few months ago artificial camphor was little more than a scientific curiosity, but within the last two or three weeks it has been placed on the market in serious competition with the product of the camphor tree of Formosa. This event marks a new era in certain industries in which the use of camphor is essential, and will possibly be the starting-point of new commercial enterprises.

In 1899, four years after the forests of Formosa became the property of Japan, the camphor industry was placed under Government monopoly, and the world became practically dependent on Japan for its supplies. In due course the price of camphor began to advance, and eventually reached such a figure that not only were industries dependent upon camphor crippled but great encouragement was given to scientific research in the direction of finding a chemical substitute for the natural product which was so difficult and so costly to obtain. This price, which at one time was 50*s.* per cwt. for the raw product, advanced to 400*s.*, and remained there long enough to do considerable damage to industry. In fairness to

Japan it must be said that certain difficulties arose in Formosa which rendered the cost of camphor collection much higher; but as these difficulties were gradually overcome, the monopoly showed no disposition to make equivalent concessions to purchasers. It is believed that the Japanese contemplated the manufacture of celluloid, and, in fact, it is stated that this industry is already carried on to some extent in Japan. Had it not been for the recent triumph of science, there is a possibility that in course of time not only would Japan have held the monopoly of camphor production, but would have secured a predominant share in all those industries in which the use of camphor is required, including such important branches of commerce as the manufacture of celluloid, smokeless gunpowder, a certain class of disinfectants, and a number of popular medicines.

FREE FROM CHLORINE.

The synthesis of camphor has been promised for some time, and in fact an impure product has been obtainable on a small scale for more than a year. The difficulty hitherto has been to produce synthetic camphor free from chlorine at a reasonable cost, and these difficulties have only just been overcome. Apparently until a few months ago the Japanese Government felt assured that both these obstacles were insurmountable, for it was not until the end of March this year that it introduced an important change in camphor distribution, and within the last four months the price of the refined natural product has dropped to the extent of 45 per cent, the last reduction, equivalent to £28 per ton, having taken place a few days ago. The price of natural camphor, however, is still substantially higher than that at which the synthetic product can be produced, and there seems to be little doubt that in course of time the competition of the synthetic article will bring the price of the Japanese product very considerably below its present reduced value. It is estimated that at least two-thirds of the world's supply of camphor is absorbed in the manufacture of celluloid, and the new source of supply will therefore prove an enormous stimulus to this industry. The demand for celluloid goods is steadily increasing, and as a result of the excessive prices that have been ruling in the camphor market, the increased demand has to some extent been met by

cheap imitations of celluloid largely composed of shellac to which a very small percentage of camphor has been added.

EFFECT ON TURPENTINE MARKET.

Patents for the production of synthetic camphor are being worked in Germany, France, Switzerland, America, and England, and most of the processes are based on the production of pinene hydrochloride from turpentine, the pinene hydrochloride being changed into isoborneol, which is oxidised to camphor. As turpentine is the most important raw material on which the synthesis relies, it is clear that the future of the camphor market depends very largely indeed on the cost of turpentine. If turpentine were to remain somewhere about its present price, it is possible that in due course the value of camphor might recede to nearly one-half the figure now quoted for the refined product. Turpentine has been dearer than it is at present, and it has been very substantially cheaper, but an increased demand occasioned by the manufacture of camphor would doubtless have a hardening influence on the market, and if this were aided by an increased demand for the purposes of paint and varnish manufacture, the cost of synthesising camphor might be considerably higher than at present. These are possibilities which must be taken into account, but unless some quite unforeseen circumstance should arise to enhance the value of turpentine more considerably than the influences, just mentioned synthetic camphor could still be produced at very much less than the present selling price of refined natural camphor. There is also the possibility that cheaper methods of synthesis will be devised, and then Japan may stand in the same position with regard to synthetic camphor as does India to synthetic indigo. In appearance the new camphor is identical with natural camphor, and chemically they are the same. There is this distinction, however, between the two products—that while natural camphor rotates the plane of polarisation to the right, synthetic camphor, like other synthetic substances, has no action on polarised light. This is merely a technical difference which has no bearing on the use of the new product in the industries.—(*Indian Trade Journal*).

VOLUME XXXIV NUMBER 2

INDIAN FORESTER

FEBRUARY, 1908.

FAMINE FOODS.

Now that famine or scarcity prevails in many parts of India, we naturally turn our attention once more to the study of the edible products of the forests. These play a very important part at such a time in the lives of the poorer classes. Government, by opening out the forests in times of scarcity, confers an incalculable boon on persons who are driven by want to make use of anything that can possibly be used as food. The study of the products thus used and of the ingenuity displayed in preparing the most unlikely kinds to render them fit to eat, is quite a fascinating one. In ordinary seasons it is, however, a study difficult to pursue and our knowledge on the subject is by no means complete. Now, again, the opportunity has come to take up the subject, and we wish to draw the attention of our readers to it.

In the famine of 1896-97 Mr. T. E. D. Innes, then Agent to the Maharaja of Balrampur, made a most interesting collection of the products used for food by the poor people in the Gonda District, U. P. He made a list of all the products that he became acquainted with, and noted the methods used in preparing them. Mr. J. F. Duthie, then Director of the Botanical Department of Northern

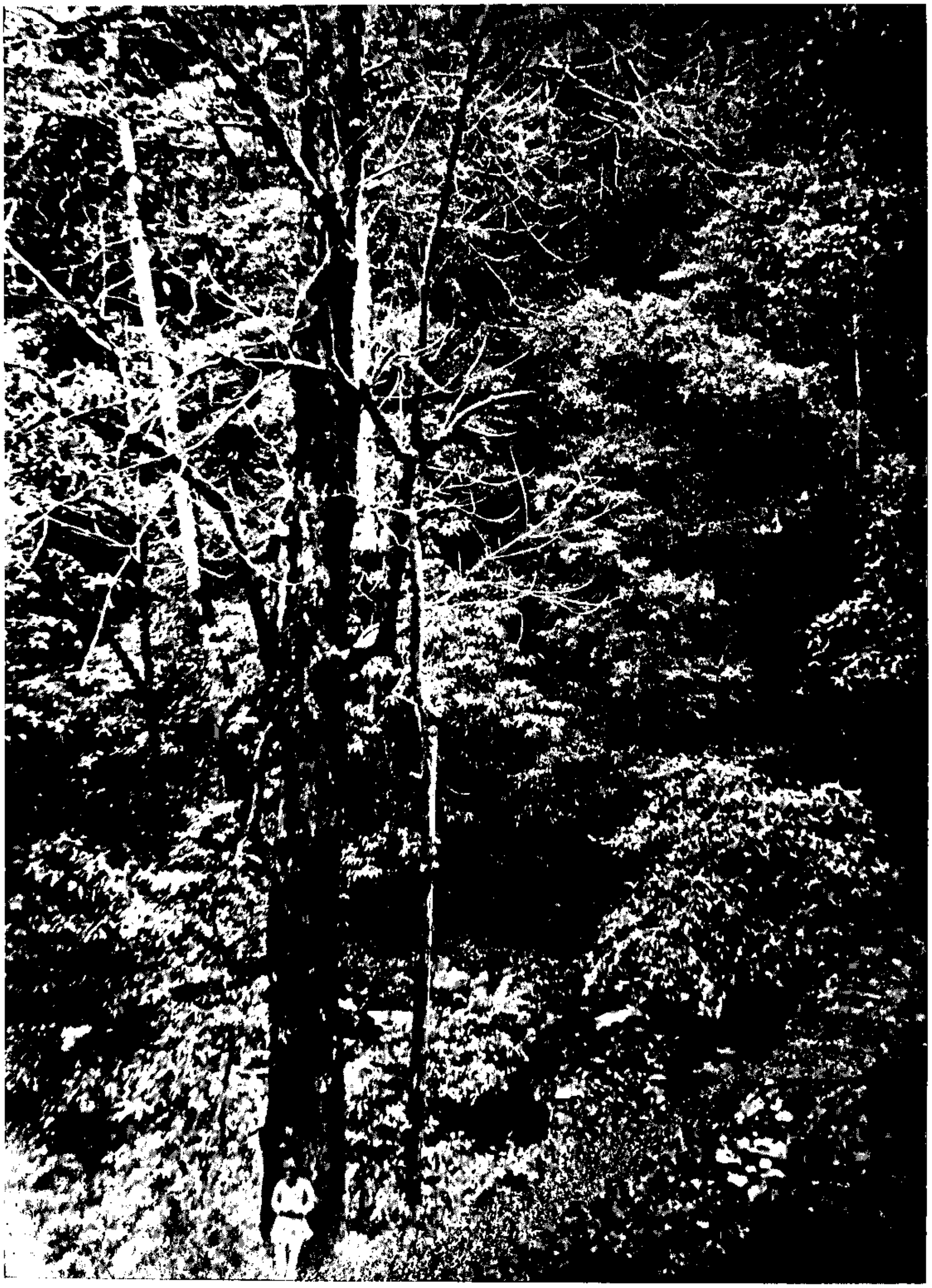


Photo. Mechl. Dept., Thomason College, Roorkee. Photo. by P. H. Clutterbuck.

Natural graft of Æsculus indica, Linn.
(The Indian Horse chestnut) near Chachpur,
Jaunsar Division. U. P.

India, identified as many of the products of the collection as he could and Mr. Innes had the list printed. By his kind permission we are able to circulate a reprint of the list as an appendix to this number of the *Indian Forester*.

From the list it will be seen that many products, known to be used as food, are still unidentified. There are undoubtedly very many more, particularly those occurring in other districts, which are not included in the list. We ask those of our readers who have the opportunity to try to obtain specimens of all products, especially forest ones, which they find are being used for food. It is very necessary too that they should keep notes, as to the methods of preparing each kind, for in one part of the country it may be known that by preparing a certain product in a certain way it can be rendered edible, while in another part, though this same product may occur in abundance, the method of preparation in order to render it fit for food may be quite unknown. It would be useless to tell the people in this latter part that they could eat this product unless the way of preparing it was also explained to them.

The identification of plants of which the leaves, flowers and fruits can be obtained is comparatively simple. It is the roots, bulbs, etc., which are often difficult to identify, since frequently there are no other parts of the plant obtainable at the time. This is particularly the direction in which Forest Officers can help. Specimens of such roots or bulbs should be collected and planted out in a garden or prepared patch of ground, each being carefully labelled. Then botanical specimens can be obtained in due course, and the product identified.

On another page of this number we give a copy of a circular from the Inspector-General of Forests directing that forest botanical specimens should be sent to the Director of Botanical Survey of India, Sibpur, for identification. We are sure that the Reporter on Economic Products to the Government of India, Calcutta, will be very pleased also to receive specimens of any edible products, together with any notes which may be available regarding each. Both these officers will gladly intimate the scientific names of specimens to the senders of the same.

As we have before stated the subject is a most important one, and any help towards advancing our knowledge of it will be most useful and valuable. We therefore trust that many of our readers will do what they can to help in this matter.

SCIENTIFIC PAPERS.

SCIENTIFIC PAPERS.

FORESTS AND RAINFALL.

BY M. HENRY, PROFESSOR OF L'ECOLE NATIONAL DES EAUX ET FORÊTS NANCY.

TRANSLATED BY R. S. PEARSON, I.F.S., F.L.S.

The following is a free translation of a portion of an article by M. Henry on the above subject. The first portion which is not here translated deals with the levels of subsoil waters in and outside forests, a subject already dealt with in the number of the *Indian Forester*, for February 1907.

The next portion of this pamphlet continues as follows:—

II.—The atmosphere contains more moisture in the neighbourhood of forests than elsewhere.

Let us admit for the present that the experiments made in Russia, Fran ceand India, between latitude 20° to 60°, are correct; *i.e.*, that the level of subsoil water is lower in, than outside, a wooded area. What would then be the result of such an experimental fact?

In the extensive plains of the Landes of Gascony, to take for example, the locality where the latest experiments regarding subsoil water have been carried out, the rain falls in equal quantities on the fir forests and on the adjoining cultivation. What, then, becomes of this rain water?

A portion (e) is retained by and again evaporates from the plants; another portion (e') evaporates on and from the soil; a third portion (r) flows off the surface, down the "thalweg" to the rivers; a fourth portion (i) is absorbed by the soil and attains a maximum at saturation point; a fifth portion (a) is absorbed by the plants and helps in their growth and transpiration; and lastly the surplus (S) sinks into the subterranean reservoirs and feeds the

subsoil waters, the upper level of which again appears on the surface in hilly districts in the form of spring water

Let T be the total rainfall.

Then we have

$$T = e + \acute{e} + r + i + a + S.$$

Now in the plains the portion (r) which flows off the surface is negligible, so that the amount which reaches the subterranean reservoirs will be

$$S = T - (e + \acute{e} + i + a).$$

Again since S is less in forests, it follows that the total $(e + \acute{e} + i + a)$ is greater in forests than outside, T being constant. Now considering the amount (i), which is absorbed by the soil to saturation point, to be equal in and outside forest, since we are reckoning with soil of uniform constitution in both localities; the portion ($\acute{e}$) which evaporates under and in a forest is less than the amount which evaporates outside; as a proof of this you have only to inspect the roads both in and out of forests and you will find that the former remain damp much longer than the latter. The equation, as far as it is necessary to examine it for differences in and outside forest, therefore resolves itself into

$$S = T—(e + a).$$

Since T is constant and S is less in forests than outside, one is forced to admit that the amount (e), that portion which is caught by and again evaporated from the plants, and (a) the amount absorbed by them and which goes to help their growth, are greater in forest than in the fields. It is unnecessary, at the same time, to take account of the quantity of water required for the formation of the tissue, that is to say the water fixed by the plants. This amount is, as a matter of fact, insignificant in this equation, as it is the same for forests as for cultivation; that is to say, it is about 3,000 kilogrammes per hectare per year; for of the 6,000 kilogrammes of dry organic matter which is yearly produced by a forest, by a wheat, by a hay, that is to say, by any crop is made up of one half water and the other half of carbon.

The deductions arrived at from the above facts may be summarised as follows :—In localities where it has been found that

the subsoil waters have been lowered by the action of forests, the amount of water which evaporates from the leaves of the trees is greater than the amount which evaporates from other crops—(and this without making any distinction between that quantity which is deposited by rain and evaporates from the leaves and branches and that quantity which is taken up from the soil and is passed through the body of the plant and tissue of the leaves)*. One can even approximately measure this difference.

Let us take for a minute the minimum depression of 30 centimetres in the subsoil level lately found to exist in the Mondon forest near Luneville in France.

The porosity of this strata is from 45 per cent to 55 per cent. Let us take it at 50 per cent.

This depression of 30 centimetres would then correspond to a rainfall of 15 centimetres, which per hectare represents a volume of 1,500 cubic metres †. When the forest can dispose of a sufficient supply of water, to reduce the subsoil level as above shown in the forest of Mondon, then this volume of about 1,500 cubic metres per hectare is given off as vapour. Such are approximately the conditions now existing in the plains of Lorraine, where before forests existed drainage had to be resorted to ‡.

Now some people might object to the above on the ground that it is only a theoretical calculation, and they may ask if no

* NOTE BY TRANSLATOR.—Though I agree with the final conclusions arrived at by M. Henry, I think that taking the quantity (i), that is the amount absorbed by the soil to saturation point both in and outside forest, to be equal on account of similar constitution of the soil is open to criticism. In nature owing to the collection of dying leaves and a thick bed of humus in a well-managed forest the point of saturation is much higher in forests than outside. If my conclusion be right then the equation

$$S = T - (e + a)$$

is incorrect, for as (i) increases in a forest ($e + a$)—though admittedly greater—in forests are reduced in intensity as (i) increases for forests.

Again, I admit (e), the amount which evaporates under and in a forest, to be less than outside but no account is taken of the very quantity in excess which evaporates outside the forest and which increases the moisture of the atmosphere outside the wooded area, this amount should in my opinion be put in the balance against the quantity given off by a forest.

Several times refilled during the period of vegetation.

‡ It must be understood that the above is only a vague example given to explain the phenomenon.

practical proof can be put forward in support of this statement that greater quantities exist over wooded areas than elsewhere.

It is to-day a proven fact, but it has only been possible to make such a statement after many years of research, for as long ago as de Humbolt's time it is said that he had worked to prove this fact. From experiments made by various meteorologists, and especially those made by M. Fautrat, it has been found that the atmosphere over forest areas contains more moisture than the atmosphere over bare or cultivated plains at the same elevation and that conifers exceed broad-leafed species in this respect.

" If the moisture given off by forests, " writes the author " was visible as fog, one would see all the forest areas enveloped by a damp mist, it being more intense over conifer than over broad-leafed forests." As it is one sees, not infrequently, the moisture in the form of small clouds over a wooded area even though the wind be fairly strong.

Attempts have been made to estimate this enormous transpiration in large forests; but reliable data are very hard to collect, for to reproduce artifically conditions similar to those in which trees are found in nature is extremely difficult. The figures obtained up to the present are, therefore, only vaguely approximate, the more so will they be open to doubt when it is remembered that the variation in the absorption and transpiration of any tree must vary greatly from year to year according as the temperature and rainfall increases and decreases. The only figures which can be quoted are those given by a well-known Austrian, Dr. Franz R. von Höhnee, who carried out observations over a period of three years (1878—1880). He found that one hectare of oak forest, 115 years old, absorbed in one day 25,000 to 30,000 litres of water, which corresponds to a rainfall of 2·5 to 3 millimetres a day or 75 to 100 millimetres per month. Taking the period of vegetation as five months, the absorption of water would be 4,500 cubic metres of water, which would represent a rainfall of 45 centimetres. During the seven months of rest which we have in our plains, it is quite evident that a very fair proportion of the moisture precipitated (rain, snow and rime) is withheld by the ramification of the trees and also by the underwood,

which moisture again evaporates into the atmosphere, without ever reaching the soil, and this again must be added to the 45 centimetres which is given off during the period of vegetation.

The observations made by meteorologists on land can only be made up to a few metres above the level of the forests; we can, however, turn to observations made by balloonists for further data. Here is what was written in 1900 by M. Renaud, Commander of Engineers, and Sub-Director of the Central Military Balloonist Establishment:—" To my knowledge the decrease in temperature which exists over extensive areas under forests has never been actually measured by balloonists, but its existence has at once been shown by the marked descent of the balloon when crossing such areas. This tendency of the balloon to fall is not checked after falling a certain distance as is often the case from other transient causes; it can only be stopped by an often considerable discharge of ballast. In any case, it is certain that many military balloonists have noticed this fact, while passing over the forests of Orleans (30,000 hectares), and that it is felt to a height of about 1,000 metres above the forest. It may, therefore, be safely stated, in all cases of balloon ascensions up till now, that the influence of considerable extents of forests have always been felt up to a height of about 1,500 metres."

III.—Forests as rain increasing agents.

If one admits the last two statements (*i.e.*, that the subsoil waters are lower in forests than outside its influence and that forests reduce the temperature while they increase the moisture in the atmosphere), one a corollary of the other, it is impossible not to arrive at the conclusion that extensive forests, humidifying and cooling the atmosphere even to a great height, are favourable to the condensation of the atmospheric moisture. If a current of warm air highly charged with moisture and close to saturation point comes in contact with the column of moist air from 1,000 to 1,500 metres in height, which has been cooled down by evaporation from the forest, favourable conditions are at once set up for the condensation of a certain portion of the moisture in the warm current, which will either form clouds or be precipitated as rain or

snow. It is therefore evident that more rain will fall in or about extensive forest areas than over the bare or cultivated plains.

This point has been experimentally proved in several places. The facts were first established at the Forest School at Nancy, and the figures arrived at were afterwards corroborated in various places in France, as for instance in the Forêt d'Halatte (Oix), in the Forêt de Troncais (Allier), in the Forêt de Mormal (Nord), also in Russia, and even as far as India.

M. Mathieu, at Nancy, has found the increase to be 15 centimetres. Ebermayer in Germany, Bouvard at Mormal, and Blanford in India estimate it at 12 per cent greater in forest than in the plains. It is naturally impossible to give constant figures even for one forest, for one has to take the mean of many years before one can even obtain approximately accurate figures. Again figures will vary from year to year according as the year is dry or wet, hot or cold, *and according* as the prevailing winds blow from one quarter or another in any given year. The effect of the forest could be even *nil* at any given period and still what has been stated would be generally correct.

The moisture given off into the atmosphere by forests may often not be condensed into rain or clouds at once, but may be carried to a great distance over the country or out to sea before it appears as rain. It remains an established fact, nevertheless, that owing to forest influences, the amount of moisture in the atmosphere is increased everywhere and that forests increase the chance of rain, though even the most exact observations could never account for all this increase.

Forests cannot create water by themselves; it is necessary for the forests to procure their moisture from some source, otherwise they could not increase the moisture in the atmosphere to a height of 1,500 metres; the supply can only come from the soil, and this absorption by forests must necessarily be greater than that of other crops, since it is only forest crops that produce their effect on balloons.

It might be put forward that by taking the evaporation as equal, the difference of height in field and forest crops, which at the

most could be 50 metres, would account for this effect on balloons. This difference is, however, absolutely insignificant when one considers that it is felt as far up as 1,500 metres above the surface of the ground. Even putting the effect at which it is felt as 300 metres, only a stronger transpiration can be given as an explanation.

In summarising the above conclusions we find that when a forest has a sufficient amount of water at its disposal, it acts as a suction pump of extraordinary force. It taps the subterranean waters to a depth unattained by any other organism, and pumps this otherwise unutilised supply of moisture again into the atmosphere to carry out its predestined roll which is the veritable backbone of life on the earth's surface. This water thus transformed into vapour and discharged into the atmosphere falls again sooner or later as rain or snow, the beneficial effects of which are found in the greater moisture of the surface layers and the nourishment of the roots, both factors so necessary to good tree growth. On the other hand this power of forests to drain the swampy areas is shown by the drying up and increase of sanitation of such localities as the plains of the Landes, the Pontine Marshes, etc. The roll of forests in this respect is too well known to require further explanation.

IV.—To what extent do forests increase the rainfall in any locality?

It is impossible to answer the above question definitely. One can only say that from observations made in various localities, rainfall in a forest region increases from between 8 per cent and 15 per cent over and above the normal rainfall. It is clear that this is not a very high percentage, but at the same time it is by no means a negligible quantity. In a discussion such as this it is necessary to consider various sides of the question. For example the well-known Engineer Surell states: "As far as meteorological forces are concerned the action of forests is negligible." It is probable, however, had Surell known of the action of forests on subsoil waters, and their effect on the atmosphere which has been proved by so many eminent men in recent years, he would never have written such a statement. On the other hand, we can examine a

pamphlet recently published in Algiers entitled "Eau and Boisement"; we find that the author at once recognises the great importance of the forests of Algiers. He writes in one place as follows :—" It is stated that here the forests help the rainfall ; they increase the moisture of the clouds ; they cool the atmosphere and thus facilitate condensation ; they catch the passing clouds and extract their moisture." This is what we foresters think and it is what has been found out by foresters and balloonists.

The author adds :—" This theory has been upheld by well-known authorities, but on the other hand well-known men think otherwise. Here, for example, is M. Dessoliers who cites M. Renon :—" A forest which stands only a few metres above the ground can scarcely affect large masses of air rising several hundreds of feet above the ground." As in the case of Surell, these lines by M. Renon would probably never have been written had he been in possession of the observations recently made by balloonists and confirmed by the Commandant Renard.

V.—Forests as an agent in helping to augment the supply of springs.

The lowering action of the forests on the subsoil water level in the plains is in no way in contradiction to the useful influence they have on the subterranean waters in hilly countries, where the water is not practically stagnant as in the plains but is continually in motion.

These are two absolutely different cases. In regions where the stratification of the rock is horizontal, such as in the cases already mentioned, *i.e.*, the Steppes of Russia and the Landes of Gascony, there can be no springs : the water comes from the rains and cisterns. What does it matter if the water level in such places is lower by a metre than elsewhere ?

Springs only occur in undulating and hilly country, where the permeable strata is more or less inclined, contorted or twisted, and where such strata alternates with analogous impermeable rock. It is on the upper side of such an impermeable outcrop that springs are to be found, provided a sufficient slope and rainfall occurs. There are several strong proofs which can be put forward in

support of the well-known fact that forests augment and sustain the deeper-seated supplies which feed the springs, while, on the contrary, forests tend to hold in suspension the more superficial waters. To mention the two most important and well-known cases will be sufficient for our purpose.

Firstly—in forests well clothed with humus and dead leaves all rapid flow of surface water is checked. Now the amount of water actually held in retention after a heavy rainfall or rapid thaw is very great, even when the gradient is steep. M. Imbreaux found it to be over 33 per cent of the total fall, his observations being taken during three severe showers which crossed the river Durance; M. Landes on the other hand found it to be as much as 42 per cent for the Danube at Vienna. Let us suppose a storm lasting half an hour gives 1 millimetre per minute. Out of the 30 millimetres, or in other words out of the 300 cubic metres which fall per hectare on a steep slope, one-third at least, *i.e.*, 100 cubic metres per hectare are retained by a well covered soil, and this humus covered soil continues absorbing water to saturation point, the water at the same time gradually sinks to the impermeable strata and if cracks or crevices are present, it again sinks to the subterranean reservoirs, the overflow of which comes to the surface as spring water. On the contrary, had the surface been bare or even only clothed with grass, nearly the whole of the rainfall would have been precipitated down the "thalweg," and instead of profiting the soil or helping towards the supply of the deep-seated reservoirs, it would have not unlikely caused sudden and disastrous floods in the valley. These facts are so well known and have been so often expounded that it is not here necessary to say more on the subject.

The above conditions do not hinder the saturated humus from drying slower than similarly situated slopes not covered with humus, and for this reason, that especially during the period of vegetation, the roots absorb large quantities of moisture.*

---

* Note by Translator.—It is, however, a fact that areas under forest do remain damp and moist longer than elsewhere, a fact that is more beneficial than otherwise in India and Europe except as far as health of people living in the forest is concerned.

These two facts, apparently in contradiction to one another, can very easily be explained. Instead of heavy rain or thunderstorms, let us examine the case of the winter snows, which even in the hilly country of the greater part of France, but especially in the higher hills, play the most important part in the yearly resaturating of the soil, and the reprovisioning of the subsoil waters. Let us take as an example a steep slope of say 45° covered with forests to the left and bare or only grassy covering to the right. In winter both slopes are covered with snow, the layer will be thicker and more regular in the forest portion because there are no avalanches, the evaporation is less and the snowdrifts very restricted in size.

Then comes the spring and the quick thaws. On the bare slopes where nothing stops the hot winds, the thaw will be very rapid and the greater portion of the water will at once run into the "thalwegs" not having time to penetrate into the soil. It is a well-known fact that heavy and sudden floods are nearly always the result of a sharp thaw of the winter snows in the hills of which the slopes are either bare or only covered with grass. Such were the causes of the terrible floods of 1856.

"The quantity of water which filters into the ground," says M. Imbreaux, "amongst other conditions is regulated by the time the water is in contact with the soil. Now this period of contact depends partly on the rainfall itself (or on the time the snow takes to melt) and partly on the time during which the water stagnates or takes to run off the surface, that is, the time it takes to disappear from one cause or another. Here also the slope is a factor which has to be taken into account, for on its gradient depends the rate of flow. It is for these reasons that in the unwooded hills the drying up of the slopes soon follows after rainfall, and owing to the steep gradient the unhindered water has little or no time to penetrate into the soil."

On the wooded half of our slope, snow will melt much less rapidly, for in forests in the hills snow lasts 15 days and even a month longer under the shelter than outside. Even taking the case when no leaves and humus exist in a forest, the fact that

snow melts slower under the shade of the trees will have the effect of reducing the excessive magnitude of the floods. As a matter of fact, the surface of the soil in a forest is always more or less covered with humus, and with a layer of half decomposed leaves which acts as a sponge. This layer which has a remarkable capacity of absorption can hold in suspension from four to five times its own weight of water* and the water so held in suspension is only given off drop by drop. The soil just below this layer of humus is protected at the same time from excessive evaporation, and can the more easily retain the water to saturation point during the winter in that the root system of the trees at this period of the year is practically *nil* in the hills.

Under these circumstances it is easy to understand that the forests are a strong factor in favouring the snow waters ultimately reaching and so replenishing the subterranean reservoirs.

Let us suppose for instance that a portion of this water does find its way down the slopes; it will flow slowly, continually meeting the interlaced root systems of the trees, which intercept its downward course, besides which on its way down the trickle of water will have a fair chance of being intercepted by a non-saturated strata which will absorb it and allow the water to filter down to lower levels, thus from these various causes practically the entire flow will be stopped on a wooded slope, even if the soil itself is not highly permeable. This is not only theory but a fact which can be frequently observed on the hills. It is true that in hilly districts the streams rise nearly always when the snow melts, or after a heavy rainfall, but they rise slowly, and what is still more marked under such conditions is the increased flow of the springs.

Secondly,—There is another beneficial influence which forests exercise over the springs and that is that well wooded hills have a much stronger influence on the precipitation of moisture from the atmosphere than bare hills.

This is due to the increase of moisture and to the lowering of the temperature over forest areas.

* Henry has found that 100 grammes of dry spruce needles dried at 100° absorbs 415 grammes of water, while the same quantity of dry beech leaves absorbs 538 grammes.

In various treatises on meteorology one finds statements regarding the influence of hill ranges on the condensation of the moisture in the atmosphere.

We will here cite one typical example with regard to this influence.

M. Argot has published in the "Annales du Bureau Central Meteorologique de France" for the year 1903, an important treatise on the "Regime des Pluies dans la Pénisule Ibérique." By examining the charts of the monthly and mean annual rainfall for this peninsula, one sees that the rainfall for June, July and August is very different to that of the preceding months. In June only 50 millimetres fall in the north. In all the south of Spain only 25 millimetres fall during this month. In July and August only 10 to 25 millimetres fall in the centre and less than 10 millimetres fall in the south.

These are, therefore, very dry months. Now, M. Argot writes that the wind generally blows from the sea during this period, but owing to the excessive heat of the soil, the moisture laden winds are further heated on arriving inland and are therefore further removed from saturation point than ever. In all this mountainous region which covers the provinces of Grenada, Jaen, and Murcia, in spite of the proximity of the sea, in spite of the non-existence of a hill range to the west which might precipitate the moisture before arriving at these hilly regions, in spite of the presence of high peaks, some attaining an altitude of from 2,000 to 3,500 metres in these provinces, the rainfall during July and August does not exceed 10 millimetres. It is probable, not to say certain, that were these ranges of hills, which stretch between the Sierra Navada and the Sierra Segara, wooded as far as it is possible under existing circumstances, that there would be found an improvement in the rainfall towards the south-east of Spain where only too often at other times disastrous floods occur.

The prevailing winds in the south of Europe blow generally from the west in summer and these currents contain a large quantity of moisture; but owing to any such cooling agents as forests on the plains, or still better of wooded hills, they are not

reduced in temperature and consequently do not precipitate their moisture until meeting same aerial cooling agent. It is partly owing to the predominance of the hot south and south-west winds and the absence of cool north and north-east winds in summer which account for the scarcity of summer rains in the unwooded areas of southern Europe. It is in localities where extensive woods occur, both in plain and hill districts, that the column of damp cool air given off from the forest vegetation mixes with the warm and highly saturated aerial currents—though still far removed from saturation point—and reduces them sufficiently to produce condensation often followed by rainfall.

It is chiefly the configuration of the ground which affects the rainfall; it has been commonly acknowledged for many years that a chart of the rainfall is very similar to a contour chart. Not infrequently, however, one finds cases (as in Spain) of large ranges of hills not producing this effect, and this occurs when the temperature of the range is higher than that of the air currents; the reduction, in such cases, of the temperature caused by the ascension of the air currents is counterbalanced by the increased temperature of the hillsides, so that the final result is that the temperature of the atmosphere is not sufficiently reduced to produce precipitation of the moisture. Such are the conditions notably found in summer in Spain and Algiers, where the wind coming directly from the sea is at a much lower temperature than that of the land; it is therefore further warmed instead of being cooled as it ascends to the higher plateaux.

There is one infallible way in which this precipitation can be brought about and so produce beneficial rains, if one is to believe the facts set out by practical meteorologists (aeronauts and foresters) and that is reafforestation whenever the climate is still sufficiently good to allow such undertakings.

Taking all conditions as equal, wooded hills are better agents towards helping precipitation than bare hills. It is to be regretted that up till now no series of experiments regarding the increase of rainfall in and out of forests have not been carried out in the hills as has already been done in the plains.

DISTILLATION OF CINNAMON OIL.

The apparatus used for distillation of this oil consists of three earthen pots, serving as boiler, covering pot and receiver, with two short tubes of bamboo to conduct the steam from the boiler to the condenser. The large earthen pot which acts as boiler is placed over a furnace; water is poured into it to a depth of nine inches. Fairly matured green leaves of *Cinnamomum Tamala* are packed into it. One head-load of leaves will fill the boiler twice. A small earthen pot (*chatti*) is kept with its mouth down over the boiler, the joint being well plastered with clay and cowdung mixed. A small bamboo tube (*wate*) about a foot long and half an inch in diameter is thrust through a hole in the top of the upper pot as shown in Plate 3. To the free end of this tube another about three feet

in length is attached, the two joints being wrapped up in cloth and plastered well with the clay mixture. The longer tube is led into another earthen pot called the condenser which is fixed in a tank containing cold muddy water. The condenser is kept down by means of horizontal bars passing over its neck, the bars being pegged down to the ground. A thick wet cloth is spread over the mouth of the condenser and around the bamboo tube. The muddy water is replaced as soon as it gets heated by the steam.

The process consists of heating water in the boiler to boiling point. The steam given off absorbs the oil from the cinnamon leaves. It passes through the bamboo tubes into the condenser and is there condensed against the cool sides. The oil being heavier than water sinks to the bottom while the distilled water forms the upper layer.

The process takes about 8 to 12 hours yielding from half to one seer of good oil (1 seer = 24 tolas). The oil is used for medicine and is largely exported to cold countries. The market price of the oil in South and North Kanara varies from eight to twelve annas per seer.

The rate of royalty for each still (*bhatti*) is six rupees per annum. The working season lasts only for five months, from November to March. After this the young leaves appear and these would not yield sufficient oil to repay the labour.

The apparatus used in the manufacture of this oil, though rude, is simple and lasts a long time. The distillation process is confined to the Western Ghats where there is an abundant supply of leaves of *Cinnamomum*.

THIRTHALI RANGE,
MYSORE STATE.

B. GOPALIAH, D. D. R.,
Range Forest Officer.

ORIGINAL ARTICLES.

REORGANISATION OF THE SUBORDINATE AND CLERICAL ESTABLISHMENTS IN THE FOREST DEPARTMENT, UNITED PROVINCES.

One of the chief drawbacks to progress in the Forest Department has of recent years been the position, pay and prospects of the subordinate and clerical staff. In the subordinate service, particularly in the lower ranks, the conditions offered were so unfavourable that few natives of a good class were obtainable for the post, for in addition to the poorness of the pay and prospects, there was always the isolation in more or less uninhabited parts to be considered. Natives of a good stamp are usually adverse to leave the towns and villages, if they can by any means obtain employment therein, and it is therefore really all the more essential that the attractions offered should compare favourably with those other services. With regard to the clerical staff, the pay and prospects even in accordance with the reorganisation of 1901* were not sufficiently good to attract and retain good men. The clerkships were generally filled by men of inferior abilities who were unable to obtain appointments elsewhere or men who accepted employment with the intention of resigning as soon as they could obtain better posts.

The result of this unattractiveness of the service in both these branches has seriously hampered progress of late years. Much unnecessary work too has been thrown on Divisional Officers owing to the consequent inferiority of these establishments.

This unsatisfactory state of affairs led up to the recent reorganisations which it will be convenient to note on separately.

SUBORDINATE STAFF.

The Conservator of Forests for the Western Circle, Mr. L. Mercer, initiated the proposals in his letter to Government dated

* This reorganisation was initiated under G. G. O. Circular No. 36F., dated 22nd November 1892, and was finally sanctioned in G. G. O. No. 919F/68-23, dated 23rd August 1901. It thus took nearly nine years to carry through with the result that when orders were passed the sanctioned scheme was already obsolete and gave satisfaction to no one.

the 6th August 1906. Final orders have been received giving effect to the new scale with effect from the 15th November 1907.

Forest Guards and Chaprasis.—The number of permanent forest guards under the old scale was 411, out of which 145 were on Rs. 7 and Rs. 6 per mensem. The reorganised scale provides for an increase of 89 permanent posts ; a minimum pay of Rs. 8 per mensem, and a more equal distribution between the grades. The number of menial posts on the permanent establishment were recently only 35 of which 7 were on Rs. 6 per mensem. These have now been increased to 68 with a minimum pay of Rs. 7 per mensem. The following table compares the new scale with the old :—

Old scale.			New scale.			
Number.	Designation.	Pay.	Number.	Designation.	Pay.	Increase per mensem.
		Rs.			Rs.	Rs.
42	Forest Guards at Rs. 12	504	150	Forest Guards at Rs. 12	1,800	
84	Do. ,, 10	840	150	Do. ,, 10	1,500	
140	Do. ,, 8	1,120	200	Do. ,, 8	1,600	
61	Do. ,, 7	427				
84	Do. ,, 6	504				
411	Total ...	3,395	500	Total ...	4,900	1,505
11	Chaprasis at Rs. 8 ...	88	1	Daftri at Rs. 12 ...	12	
17	Do. ,, 7 ...	119	2	Jamadars ,, 10 ...	20	
			25	Chaprasis ,, 8 ...	200	
7	Do. ,, 6 ...	42	40	Do. ,, 7 ...	280	
35	Total ...	249	68	Total ...	512	263

The scale of forest guards is still however to be supplemented by 85 posts of beat-guard on the temporary establishment, but the minimum pay for these has been raised from Rs. 5 to Rs. 7. It has been laid down that these temporary appointments will serve in future as places of probation. By chaprasis is meant office peons and the orderly peons of the gazetted staff.

Foresters, Deputy Rangers and Rangers.—Until recently there were four grades of Foresters on Rs. 20, Rs. 18, Rs. 16 and Rs. 14 per mensem. The reorganisation substitutes three grades on Rs. 25, Rs. 20, and Rs. 15 per mensem. The number of posts remains the same. The pay of the Deputy Ranger grades is the same as previously, but the posts have been increased by six. The number of posts of Forest Ranger has not been increased nor the pay of the grades, but a more favourable distribution has been made between grades. The following table shows the improved scale compared with the previous one :—

Old scale.			New scale.			
Number.	Designation.	Pay.	Number.	Designation.	Pay.	Increase per mensem.
		Rs.			Rs.	Rs.
7	Foresters at Rs. 20	140	12	Foresters at Rs. 25	300	
6	Do. ,, 18	108	7	Do. ,, 20	140	
6	Do. ,, 16	96	6	Do. ,, 15	90	
6	Do. ,, 14	84				
25	Total ...	428	25	Total ...	530	102
10	Deputy Rangers at Rs. 40	400	12	Deputy Rangers at Rs. 40	480	
10	Do. ,, 35	350	12	Do. ,, 35	420	
10	Do. ,, 30	300	12	Do. ,, 30	360	
30	Total ...	1,050	36	Total ...	1,260	210
4	Rangers at Rs. 150	600	8	Rangers at Rs. 150	1,200	
4	Do. ,, 125	500	8	Do. ,, 125	1,000	
8	Do. ,, 100	800	10	Do. ,, 100	1,000	
12	Do. ,, 80	960	10	Do. ,, 80	800	
13	Do. ,, 60	780	11	Do. ,, 60	660	
18	Do. ,, 50	900	12	Do. ,, 50	600	
59	Total ...	4,540	59	Total ...	5,260	720

The reorganisation of the permanent subordinate staff thus entails an increased expenditure of Rs. 33,600 per annum, but it will at the same time involve a decrease under temporary establishment of about Rs. 10,000.

CLERICAL STAFF.

Mr. Mercer also initiated the proposals regarding the reorganisation of the clerical staff. He addressed Government on the subject on the 12th June 1907. The final orders dated 18th October 1907 sanctioned the new scale with effect from 1st April 1908 The reorganisation substitutes a permanent staff costing Rs. 4,820 per mensem and a temporary staff costing Rs. 700 per mensem, total Rs. 5,520 per mensem, for the recent permanent staff costing Rs. 3,070 per mensem and a temporary staff costing Rs. 672 per mensem, total Rs. 3,782 per mensem, thus increasing the cost of etablishment by Rs. 21,636 per annum.

The main features of the revised scale are to give the head-clerk of a Division of minor control, of which there are three in the Province, Rs. 80 per mensem, a head-clerk in a Division of major control Rs. 100 or Rs. 120 per mensem, and the head-clerk of a circle Rs. 200 per mensem. The other clerks are all termed assistant clerks and are to draw annual incremental pay Rs. 25—2—75, an entirely new departure but one which promises to give much satisfaction.

The statement below compares the revised scale with the former scale :—

Old scale.								New scale.					
Number.	Designation.	Pay.			Average cost per mensem.			Number.	Designation.	Pay.			Average cost per mensem.
		Rs.	Rs.	Rs.	Rs.	a.	p.			Rs.	Rs.	Rs.	Rs.
2	Clerks ...	125	10	175	325	0	0	2	Head-Clerks	200	...	...	400
4	Do. ...	80	4	100	380	0	0	4	Do. ...	120	...	...	480
5	Do. ...	60	4	80	375	0	0	5	Do. ...	100	...	...	500
5	Do. ...	50	2	60	287	8	0	3	Do. ...	80	...	...	240
7	Do. ...	40	2	50	332	8	0	64	Asstt. Clerks	25	2	75	3,200
10	Do. ...	30	2	40	375	0	0						
15	Do. ...	25	1	30	431	4	0						
17	Do. ...	20	1	25	403	12	0						
8	Do. ...	20	...	...	160	0	0						
73	Clerks costing ...			...	3,070	0	0	78	Clerks costing ...			...	4,820

There used to be 35 temporary clerks, one at Rs. 25, twenty-three at Rs. 20, ten at Rs. 15 and one at Rs. 12 per mensem. For these the reorganisation substitutes twenty-eight clerks all at Rs. 25 per mensem. In other words, it is recognised that in order to attract a promising man with a fluent knowledge of English, Urdu and Hindi it is necessary to offer him an initial pay of Rs. 25 per mensem.

The following extract from the orders sanctioning the re-organisation must be given in order that the conditions of service may be fully understood :—

"The scheme of incremental pay in clerical offices is a new departure, but is justified by the comparative isolation of the offices of the Forest Department from other offices, and the consequently limited opportunities of promotion for clerks in those offices. The services of a clerk for the purpose of earning an increment will count from the time of his joining the permanent establishment or of his obtaining in the temporary establishment a post subsequently made permanent under article 370, Civil Service Regulations, but it will be in the discretion of a Conservator to withhold an increment in the case of misconduct or bad work. Vernacular clerks and those who do not possess the prescribed educational qualifications for appointments in English offices or have not been exempted from the educational test rules will continue to draw the pay of the grade in which they are now serving or will be governed by the rules quoted in sections 117 and 118 of the Forest Manual. Should there be any clerks whose present pay is in excess of what their incremental pay would be, they will be allowed to draw their present pay until such time as they would become entitled to it under the proposed scheme of increments."

"The Lieutenant-Governor is further pleased to direct that no clerk shall be appointed to either the temporary or the permanent establishment who does not know English, Urdu and Hindi and has not obtained at least a certificate at the School-Final examination. Until the School-Final examination comes into force in April 1910 a pass by the Entrance examination for the Allahabad

University may be accepted but not after that date. No clerk must be appointed to the temporary establishment whose age exceeds twenty-five years. All existing local or special allowances will remain unaffected by the introduction of this scheme."

For the Rangers there is one list for the Province, for the Deputy Rangers, Foresters, Guards, menials and clerical establishment there are lists for each circle; in other words, Rangers are interchangeable between the two circles, though such transfers rarely take place, while the other classes of subordinates are not.

The main principle that has been observed in these reorganisation proposals is rather to improve the quality of the subordinates than to increase the numbers, it being held that well educated trustworthy men, although each must be comparatively highly paid, are worth twice their number of the classes that the Department has been driven to recruit of late years.

It may further be noted that once having fixed the number of posts on the two establishments for the Province or circle as may have been proposed, the Local Government leaves the distribution among the different Divisions entirely in the hands of the Conservators, in no case fixing the number of any class of subordinate in any one Division. This is a degree of elasticity as gratifying as it is sound. It indicates the confidence of the Government in its Conservators and recognises that the heads of the Department best know the needs of the various Divisions.

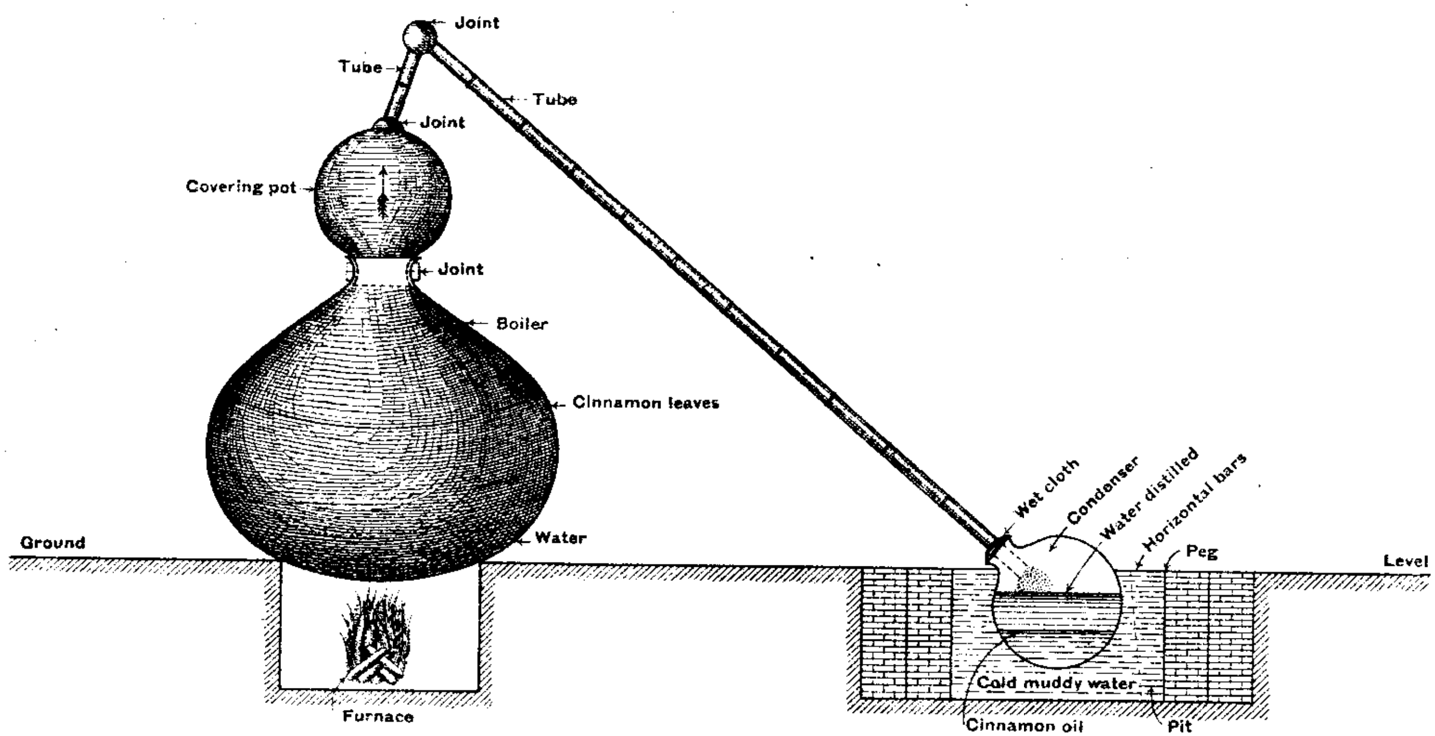
For the information of those who are not well acquainted with the United Provinces, it may be stated that the area of reserved forests is 3,934 square miles, protected forests 30, unclassed forests 43 and leased forests 157 square miles.

The whole is divided into 2 circles, 12 divisions, 65 ranges and 585 beats. The surplus last year was Rs. 10,03,234* (revenue Rs. 24,11,423 and expenditure Rs. 14,08,189).

With the prospects and pay of both the permanent subordinate and clerical establishment increased at a cost of over half a

---

* There was, however, extraordinary expenditure of over two lakhs during the year as the rent of the leased forests was in arrears. This amount should therefore be added to the surplus and deducted from expenditure.



APPARATUS FOR DISTILLATION OF CINNAMON OIL FROM A SKETCH BY R. GOPALIAH.

in length is attached, the two joints being wrapped up in cloth and plastered well with the clay mixture. The longer tube is led into another earthen pot called the condenser which is fixed in a tank containing cold muddy water. The condenser is kept down by means of horizontal bars passing over its neck, the bars being pegged down to the ground. A thick wet cloth is spread over the mouth of the condenser and around the bamboo tube. The muddy water is replaced as soon as it gets heated by the steam.

The process consists of heating water in the boiler to boiling point. The steam given off absorbs the oil from the cinnamon leaves. It passes through the bamboo tubes into the condenser and is there condensed against the cool sides. The oil being heavier than water sinks to the bottom while the distilled water forms the upper layer.

The process takes about 8 to 12 hours yielding from half to one seer of good oil (1 seer = 24 tolas). The oil is used for medicine and is largely exported to cold countries. The market price of the oil in South and North Kanara varies from eight to twelve annas per seer.

The rate of royalty for each still (*bhatti*) is six rupees per annum. The working season lasts only for five months, from November to March. After this the young leaves appear and these would not yield sufficient oil to repay the labour.

The apparatus used in the manufacture of this oil, though rude, is simple and lasts a long time. The distillation process is confined to the Western Ghats where there is an abundant supply of leaves of *Cinnamomum*.

THIRTHALI RANGE,
MYSORE STATE.

B. GOPALIAH, D. D. R.,
Range Forest Officer.

SCIENTIFIC FORESTRY.

[CONTRIBUTED.]

The article under the above heading* by Mr. Walker seems to call for a rejoinder, as it is not only misleading but derogatory to the Department in general and the Burma branch in particular. If the *Indian Forester* were read only by members of the Department, it would not, perhaps, matter much as they would

* Page 452 in the number for October 1907.

ascribe it to the idiosyncracies of the writer, but as the Magazine is distributed very widely and to people who from personal knowledge know nothing of our work, it is important to dissipate the impression that would otherwise be given, that till the new prophet arose every investigation was at a standstill.

Mr. Walker starts with the assumption that few men know what scientific forestry means: this seems most gratuitous, and is apparently based on the fact that our forests are not yet managed on the most scientific principles, considering the comparative youth of the Department and the vast areas which have to be got under some sort of control to prevent the ruin which would be inevitable otherwise, it would be marvellous if they had been. With the benefit of 50 years' observation in the past, the present experiments and the future deductions therefrom, which, Mr. Walker states, form the basis of scientific knowledge, I think he may rest easy in his mind that we shall not take 150 years to make a start in the right direction, as, he states, the French took

The statements made in the article are so sweeping and in my opinion, so inaccurate, that it is hard to know how to deal with them without writing a whole history of Forestry in Burma. I would start with the remark, however, that if our ignorance is so colossal and the collection of information is as simple as it is stated to be, it shows great lack of appreciation of his opportunities that the one officer with his eyes open has not himself done more. If, as stated in paragraph 4, the whole of the intricate problem of fire-protection could be solved in one year, other problems might have been solved in less time, and in his eight years' service Mr. Walker might have put all our work on a scientific basis. Treating the matter seriously, however, the remark that fire-protection problems could be solved in a year is absurd, and shows that the writer is omitting the first necessity for scientific knowledge, namely, observation. Observation of the effect of fire-protection for one year would give no information at all of its far-reaching effects, and but little of its immediate effects; to be effective, observation must be continued over a series of years in which the protection has been successful, and it is only lately we have had the advantage of being

able to do this. To say that no efforts have been made to collect data on this point is to wilfully ignore the figures collected by Messrs. Troup, Rodger, Beadon-Bryant, and others, and to ignore also the elaborate experiments ordered by the latter officer when Conservator and more lately in connection with the proposed abandonment of fire-protection in certain areas. In the matter of Taungya plantations again, Mr. Walker says no attempts have been made to find out the future profit and loss thereon—he absolutely ignores the elaborate calculations made by Mr. P. J. Carter. These may or may not require emendation now, but they were a very fine attempt based on fact and on the mature opinion of an experienced officer, whom Mr. Walker may affect to despise, but who with his confrères bore the brunt of starting the forest work in Burma in a way that those who know the difficulties they had to overcome can only admire.

In the matter of the very puzzling question of teak regeneration again, leaving out of the question the experiments made in the former days, Mr. Walker apparently has not heard of those carried out for years by the late Mr. Messer in Mohnyin, but he must have heard of the experiments he and other officers have been ordered to carry out throughout Burma. That the problem is not fully solved yet is due not to lack of attention but to the inherent difficulties of the problem, and though we may not know all about the matter, our knowledge on the subject is certainly not *nil.* Another good instance of an unwarranted assumption is that Mr. Nisbet based his remarks on sowing in flowered bamboo areas on a small patch which he did not visit. Why should he so base them? There were certainly hundreds of acres (in Tharrawady) which he must have seen, and there were probably others which I do not know so well. Mr. Walker is also presumably ignorant that extensive measures in this connection are in progress in the Northern Circle, and also that other attempts have been made in many divisions both in naturally flowered areas and in areas where the same state was artificially reproduced. I have no time to deal in further detail with the statements in the article in question, but I hope what I have written will be sufficient to prove that we are by no means calmly

sitting down to let our forests manage themselves, but are making every effort to solve the problems in connection therewith. I think it also shows that the former efforts of our officers have been absolutely ignored by the writer, and that the wonderful suggestions made by him are mainly based on instructions already issued. I would also add that I think the article singularly mistimed when a bureau of specialists has lately been established to collect and co-ordinate facts on the subject referred to.

CURRENT LITERATURE.

A PRELIMINARY ACCOUNT OF THE BITING FLIES OF INDIA, by H. Maxwell Lefroy, MA., F.E.S., F.Z.S., Imperial Entomologist.*—Information regarding the Indian Diptera is very scarce; in consequence this bulletin is most welcome.

In it, the general characters of the seven families which are known to suck blood are given, and each family is then separately dealt with. The following table enumerates the families concerned :—

Scientific name.	English name.	Vernacular name.
I Chironomidæ ...	Gnats	Mugatara.
	Midges	Busardi.
	(In the plains) Sand-flies ...	...
II Culicidæ	Mosquitoes	Machhar.
III Psychodidæ ...	Sand-flies	...
IV Simuliidæ ...	Sand-flies in part of the hills	...
V Tabanidæ ...	Horse-flies	Dans.
	Gad-flies	...
VI Muscidæ ...	Flies	Makhi.
VII Hippoboscidæ ...	Forest-flies	Kuku makhi.
	Horse-flies	Bagai.
	Dog-flies	Gomakhi.

As far as is known at present the flies which bite man belong to one of the first six families, for the various species belonging to the seventh are only known to bite animals. The members of *Tabanus* genus however less frequently bite man than animals.

The importance of these biting Diptera may be immensely increased when it is known what diseases they are capable of transmitting.

* Published by the Superintendent, Government Printing, Calcutta. Price, Re. 1 or 1*s*. 6*d*.

The chief aim in the issue of this bulletin is thus set forth :—

"Our object in this paper is to describe the progress made with a view to securing co-operation and recording a step in advance. We can breed some of the species likely to affect man in sufficient quantity, to supply the needs of an investigator and this is one of the first requirements in such an nquiry. But progress must be intensely slow if the co-operation of observers in all parts of India cannot be secured, and I would reiterate the hope that any one interested will communicate with Mr. Howlett at Pusa and draw freely on him for assistance. Further, I will be glad to at once arrange, so far as is possible, for breeding supplies of any of the flies (except Tabanids and some Muscids) mentioned herein for the use of investigators who wish to test their behaviour in relation to the diseases of man or cattle ; it is probable that by the time this is in print Purushottam will have solved the problem of Phlebotomus and be able to rear it readily ; the others can be reared more easily."

At the end, a chapter is given on collecting with directions as to methods of mounting, preserving, labelling and packing. The text closes with the following appeal :—

"Specimens of biting flies are wanted from all parts of India, and to any one willing to collect a copy of this bulletin with a postal store-box, pins and cork slips, tubes and a net will be sent on condition that the flies are sent as soon as possible to Pusa for study and that duplicates may be retained for preservation. The same applies to ticks, lice, fleas, etc. Knowledge about biting insects is slowly growing, and it will grow more rapidly if residents in any part of India will send specimens of insects that bite them or cattle. It will probably be found that sand-flies are too small for pinning by any but a very experienced setter, and in this case the flies are best kept in small dry corked tubes, the corks of which have been dipped in napthaline dissolved in benzene. The minutest flies keep well in this way if carefully dried before putting into tubes."

The work is illustrated by four excellent plates of which two are in colour.

FORESTRY AND IRRIGATION FOR DECEMBER 1907.—The usual editorial and notes deal with some 48 topics of current interest. We learn that the President of the U. S. A. has called for a conference on natural resources to meet at the White House on May 13th to 15th, 1908.

In his circular letter inviting attendance at the conference the President says that he believes the conservation of the natural resources is the most weighty question now before the people of the United States.

The articles in this number are—" Lumbering Possibilities, Agusan Valley, Philippine Islands" ; " Manufacture of Matches takes much fine Timber" ; " Private Forestry as an Investment in the U. S.," by Ernest Bruncken ; "Work in a National Forest" by C. H. Shinn. *No. 5, " Holding Down a Forest Fire."—This is a continuation* of the former articles by Mr. Shinn, describing the ordinary duties which have to be performed by forest officials in the U. S. reserves. The present article is of intense interest, the illustrations fully support the author's contention that it is important to save every tree, large and small, from fire, at any cost of time and money. Other articles are " Russian Mulberry in a Good Situation" ; " The Sterilization and Preservation of Electric Line Poles" ; " Marking in a Western Yellow Pine Forest."

The number is illustrated as usual with numerous and interesting photographs.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

A PAIR OF COLD-WEATHER TIGERS.

In Northern India the chief method of tiger shooting is by beating with lines of elephants. This method is hardly practicable during the cold weather, as there is then so much cover, that one's only chance is to sit up over a *kill*. However, tigers at this season are able to obtain food very easily, as they can stalk througn the thick green cover so quietly; hence, on the slightest suspicion,

Photo.-Mechl. Dept., Thomason College, Roorkee.

Photo by P. H. Clutterbuck.

FELIS TIGRIS.

they give up all thoughts of returning to their kill. In the cold weather, too, they can eat in comfort at any time of the day or night, and one never knows when they are most likely to return to their kill. It will be seen, therefore, that it is quite an event to bag a cold-weather tiger, more especially as the skins are then in such very good order. Consequently, the following account is of special interest:—

In December 1902, I was touring about the forests bordering on Nepal. When I reached my camp about midday on the 21st, I was informed that two of the buffalo calves, which had been tied out the previous night, had been killed by tigers. After breakfast which is more or less a midday meal in camp, I started off on a staunch female elephant to go to sit up over whichever kill might be in the best position. The first kill proved to be about three miles from camp, on the edge of the tree forest. The animal was a tigress, judging from the tracks, but she had dragged the kill into some thick grass, so I thought it better to go and see the second kill, which was a few hundred yards further on. This, being situated inside the tree forest, would, I hoped, give a better chance. We found that the kill had been dragged away, as is generally the case with tigers. We followed the marks of the drag as quietly as the mahout (elephant-driver) could get the elephant to go. The tracks appeared to be those of a remarkably big tiger. He seemed to be a very wary one, for he had dragged the kill for several hundred yards through most beautiful cover. When we had gone about 300 yards I suddenly saw a dark object in dense shade some 50 or 60 yards ahead. I immediately covered this with my rifle. However, it then seemed to me that it was only a blackened stump, so I lowered my rifle. By looking again very carefully I made out the curve of the top of the tiger's head and the two pointed ears. The beast appeared to be sitting up on his haunches, trying to peer through the cover, doubtless thinking that the stealthy tread of the elephant was that of his mate. Raising my rifle again, I quickly aimed for his chest, but the cover being so dense, it was very hard to make out which way he faced. The density of the cover may be guessed from the fact that the

whole animal appeared quite black to me, though the sun was shining brightly at the time. He answered to the shot and bounded out of sight. From the sounds which followed he appeared to fall, and we heard no more. We then carefully reconnoitred the ground, but, not finding him, returned to the spot where he was wounded to take up the track. There was so little blood, however, that after an hour we had not gone more than 100 yards. The blood then failed us, and, as the tiger had traversed the ground there at a slow, stealthy pace, we could not find his track among the many tracks in the undergrowth. The soil not being exposed, there was, of course, no trace of his pugs. Being by this time about four o'clock, the light in the forest was none too good; it is quite dark in December soon after five. I decided, therefore, to look for him in the morning, and in the meanwhile to sit up over the first kill. However, I had to break down the grass near the kill to enable me to see it; also, it was already late, so I probably disturbed the tigress, for she never turned up. I accordingly returned to camp when I could no longer see.

On the 22nd I started about nine o'clock, when the sun was well up. On arrival at the spot from which I had shot (this spot, I should have mentioned, was quite close to where the tiger had deposited the kill on the previous day, a fact which we only discovered after my shot), we found, to our astonishment, that the kill had gone. I was quite certain the wounded tiger had not come back after being hit at that place, so concluded that the tigress of the first kill was his mate, and that she had dragged away the kill, possibly towards where he was lying up. So we cautiously followed the drag for some 200 yards, and found the kill under some dense shrubs and climbers. Hoping that the wounded beast might be lying somewhere near, I told the mahout to circle round as quietly as he could. Seeing nothing, we returned to the road where the kill had been originally tied up, *i.e.*, about 500 yards back, to get my machan, in order that I might sit up at once, for in the cold weather there is a chance of the tiger returning at any moment, more especially if there is a pair. When we got back with the machan to where the kill was, we saw that it had been

dragged a few yards further under the climbers. We quickly lowered the machan into the grass and again circled around, as it was of course evident that one of the tigers was somewhere near. We had not gone far when my orderly, who was on the elephant behind me, touched me on the back and pointed out the tiger, or, rather a small patch of it, near the base of a tree. I stopped the elephant but could see nothing of the front part of the tiger, as it was hidden under dense undergrowth, only the hindquarters. It was crouching broadside on, about 15 yards off, evidently under the impression that it was completely hidden. I was unable to tell whether this was the wounded tiger or no, but, thinking that it was too good a chance to risk moving at all, I aimed for the kidneys, high up in front of the hind legs. It was the tigress we could see as she bounded off. She did not go far, and appeared to stop about 40 yards on, still under the dense cover. We circled round cautiously keeping outside the edge of the thick patch. Soon we saw a bit of her again, she was standing, evidently in great pain. I shot again, and saw her disappear into the undergrowth. We got glimpses of her now and then as she tumbled and floundered about. I had to give her four more bullets before she was still. She turned out to be a fine tigress, 8ft. 9½in. in length. She had one bullet wound on the right shoulder, which she had licked, so there was much debating between us as to whether this could have been the animal I had wounded the previous day, for this wound corresponded within a few inches to the place I had aimed at. Also now we knew there was a pair of them, we could not tell which I had chanced to see the day before. I was unable to tell whether all my six bullets of the day had hit her, as all of them had been fired when I could only see a patch of her. If she was the wounded one it explained to some extent her lying so close, otherwise it was very remarkable that she should have allowed a single elephant to come up to her when she could have so easily slunk away, but she may have thought, until too late, that it was her mate moving about ; then, when she realised her mistake, she may have tried to hide, hoping that the elephant would pass by. Altogether, it was a knotty point. My mahout, however, declared

that the wounded animal of the previous day had seemed much bigger as it bounded away. I was inclined to agree with him, but still I was not convinced one way or the other.

Next day, the 23rd, in the afternoon, I went again to the kill to see if it had been visited during the night, intending to sit up over the remains if I found that the other tiger had again been to it. Imagine our disgust when we approached the place to find two chamars, a low caste of Hindu, who removed the skins from dead animals for sale, just returning from the kill carrying the skin away. They had heard that I had killed the tigress, and did not know that there was a second one. We took the skin from them, and found when we reached the kill that the tiger had been there in the night. Having placed the skin over the small remains of the kill, I sat up till dark, but there was no sign of the tiger about.

I then had to move my camp to another place, about eight miles away. I gave up all thoughts of bagging this tiger, coming to the conclusion that I could not have wounded him seriously. On December 28th I got another kill near this second camp. I sat up for the tiger in the evening. When it was getting dusk I thought I heard him come and flop down in the undergrowth about 50 yards off, but though I waited till it was quite dark, I neither saw nor heard anything more. In the evening, when I got back to camp, I told my elephant driver to have the elephant ready an hour before dawn. Next morning we started punctually, and had to wait on the road at the spot from which the kill had been taken, for twenty minutes until it was light enough to see; then we went carefully up to the kill. It had been visited in the night and dragged further on, but we did not get a glimpse of the tiger. Luckily, however, there was a very heavy dew, so it occurred to me that I might circumvent the tiger in the evening if I could find out from which direction he was likely to come by sitting up somewhat away from the kill in that direction. We accordingly followed up his track, which was very clear then, as all the dew had been shaken off the thick grass where he had passed along. After about 300 yards we came to a little water-hole where he had drunk that morning, as well as the previous

evening. His tracks led straight on down a dried-up water-course. We followed some way, but, finding that his tracks still went on, I decided not to risk disturbing him, but to come again in the evening in order to sit up over the pool of water.

In the afternoon I got settled in my machan by four o'clock. At a quarter past I heard the tiger on the move. He walked deliberately up to the pool and threw himself down on the damp earth where a sambur stag had lately rolled. He was only 20 yards from me, but was covered by some large overhanging leaves, As he could not drink without exposing his whole body to me, I waited, watching him with profound interest, licking his paws and lolling about at his leisure. I took this opportunity to raise my rifle in readiness. As I did so he put up his head to listen intently but, hearing nothing more, he stood up and walked down to the water broadside on. He did indeed look magnificent. There was then not a leaf in front of him, and I could see every part of him Before he had time to drink I pulled the trigger. He bounded up the little bank in his death gallop, falling, as it seemed to me, about 80 yards away. I was fairly sure that I had hit him in the heart, as I could not possibly have had a better opportunity, at such a close distance, too. I called for my elephant, but the mahout did not hear me, so, after waiting some time, I got down out of my tree and walked to the road. By the time I found the elephant it was nearly dark, so I had to leave the tiger till morning. Early on the 30th we went to the spot where I had heard him fall, and found him lying stone dead. He was shot through the heart as I thought, but on his right shoulder there was the wound of the 21st as well. The bullet had gone along the body under the skin without smashing any bones. It was indeed lucky that, as I could not remain any longer at the first camp to look for him, he had taken it into his head to come on to the next camp. He measured straight 9ft. 8½in. His skin is in perfect condition, and is the finest of all I have bagged.—(*By Rock in the Field.*)

EXTRACTS FROM OFFICIAL PAPERS.

THE IDENTIFICATION OF FOREST BOTANICAL SPECIMENS.

Inspector-General of Forests' Circular No. 24/303—10, dated 28th December 1907, to all Conservators.

I have the honour to address you on the subject of the identification of forest botanical specimens. Up to the present time little work has been done in the Imperial Forest Research Institute of specialising in the matter of the economic uses of selected plants, the time of the Imperial Forest Botanist being occupied in the study of systematic botany which has little to do with the reasons for the creation of the post. With a view to giving the Imperial Forest Botanist greater freedom for the exercise of his legitimate work, I have asked the Director of Botanical Survey of India whether the identification of forest botanical specimens could not be carried out at Sibpur instead of at Dehra Dun. The Director, Major A. T. Gage, has kindly undertaken to give all possible aid in the matter, though he cannot, at this time, definitely promise to undertake the identification of *all* forest botanical specimens.

2. I would request that in future Forest Botanical specimens may be sent to Sibpur instead of to Dehra Dun for identification. Not more than 20 specimens should, however, be sent at a time, as if a larger number than this is sent, their identification is likely to be much delayed.

MISCELLANEA.

NATURAL GRAFT OF ÆSCULUS INDICA, LINN.

Plate 4 represents a very curious phenomenon of a natural graft of *Æsculus indica*, Linn, which occurred near Chachpur in the Jaunsar Forest Division, U.P. Originally there was a large horse chestnut tree and a small pole of the same species growing along-

side. The latter came into contact with a fork of the former at about 35 feet from the ground and the growth of the two became merged. Then, in making or repairing a path which passed near the smaller tree, the coolies apparently cut away the base of the small tree, but finding the uppermost part fixed in the fork of the large tree left it hanging with the lowest portion at a distance of about 7 feet from the ground. When the photo was taken, the whole of the hanging part below the fork was quite rotten, while the part above the fork was quite alive. The photo was taken after the leaves were shed, in order to show the branches.

P. H. CLUTTERBUCK.

PRESERVATIVE AGAINST WOOD SPLITTING.

It is only too well known by those interested in the timber trade that losses amounting to several thousands of pounds annually are incurred owing to the splitting of logs. Felled trees begin to crack and split at their ends after a very short period, thereby rendering useless a good portion of the wood, therefore in calculating the volume of trunks and logs the parts thus affected are always left out of the reckoning. These troubles make themselves obvious, especially in the case of beech, oak and ash wood, which are more than others subject to wood splitting, thus causing extensive losses, which were considered unavoidable because no means were then known to prevent the same.

The cause of wood splitting can be easily explained when one takes into consideration the structure of the timber and its attitude when brought into contact with humidity. Everyone knows that thin planks warp as soon as they get dry and expand when affected by the dampness of the atmosphere. As the pores lie principally in the direction of the fibres, it is easily understood that the timber begins to dry up at its ends in the first place, because the open pores which are there give up their moisture very quickly, whereas towards the middle of the timber the moisture remains much longer. Besides this, the air which penetrates

the pores to take the place of the moisture oxidises and therefore hardens the sap, which naturally accelerates the drying-up process. Now, as wood shrinks when it dries, it is quite natural for the ends of the timber to contract transversely, and as the middle parts which are still moist cannot follow this pressure, the consequence is that a certain tension is brought about causing the wood to split. From this point of view the firm of Daniel Lorach, of Mulhouse (Alsace), has, after many years' experiments, introduced into commerce a most efficacious means for the prevention of wood splitting under the style of "Preservative against Wood Splitting." The thought which first gave birth to this preparation was to prevent the timber from drying up and decaying; in the second place to prevent the air from penetrating into the pores, thereby presenting a surface proof against all chemical actions of the atmosphere. This preservative surface to be a success must be composed of a substance which is absolutely air-proof, which has no chemical action whatever in the wood, and which offers a great resistance to atmospherical and mechanical attacks of all kinds. The preservative against wood splitting which has just been introduced into the trade by the above-named inventor presents not only these properties, but also the following great advantages :—

It can be applied in the most simple way by means of a brush, drying immediately into a homogeneous surface, and at the same time is both elastic and resistable, thus taking the place of the bark.

This preservative can be used just as efficaciously with freshly hewn trees as with planks of all description. If a block of any valuable wood (say £10 worth) measuring 12 ft. in length and 2 × 2 ft. in width, is split at both ends to the depth of only 4 in., the loss amounts to 11s. 1½d. Now, it is claimed that if this preservative is used and both ends are coated with same (which means in this case an outlay of 2½d.) the saving effected on one single log amounts to 10s. 11d. Considering that thousands of logs lose part of their value through splitting at the ends, it is obvious that an enormous economy could be effected.

As this preservative penetrates but very little into the surface of the timber, and as it does not injure the wood in any way (but

on the contrary keeps it in good condition), there are no drawbacks to fear.

This preservative has already been used in manufactories of agricultural implements, in the construction of mills, in match manufactories, shipbuilding works, forestry work, etc., etc., with the greatest success. We had the opportunity a few days ago of inspecting logs that had been treated by this preservative, and similar wood in its natural state, the former had not a crack in it, whilst the wood that had not undergone the preserving process was split at the ends in all directions.

Our readers can obtain further particulars of the London agent, Mr. A. W. Christin, Peninsular House, 4, Monument St., E. C.—(*Timber Trades Journal.*)

THE PRUNING OF LARGE TREES.

This is a business which is very little understood. Go where you will, it is the rule to see trees of every description in a neglected state as regards pruning. It is quite the exception to meet with examples in a thoroughly well-cared-for condition. Such attempts as are made to prune very generally reveal ignorance of the first principles of the art. Commonest of all among these is the leaving of an ugly and, moreover, extremely harmful snag. Presumably a large proportion of our tree pruners are so ignorant of their business as not to know that a branch should always be cut off as cleanly as possible flush with the main trunk or at its junction with a larger branch. When this is not done, as there is no lateral shoot to induce a flow of sap, the wound cannot heal over, decay soon follows, and this in time is sure to extend into the trunk.

While it is a fact that trees which have apparently entered upon the stage of senile decay can, to a great extent, be rejuvenated by judicious pruning, it is often the best policy to cut them down. There may, however, be sentimental objections to this; it is possible to become so attached to an old tree that it would be a real grief to lose it. In such a case it is the wisest course to call in the tree surgeon, and as the skilled practitioner is but rarely

met with, it may be helpful to many to give a few broad directions concerning the pruning of large trees which require drastic treatment.

Two men at least will be required, and three are commonly preferable. Supposing inexpert hands to be about to undertake the task, it will be well to mention that use will be found for quite a formidable assortment of tools. When we set to work at tree pruning our outfit comprise saws (large and small), axes, choppers, and knives, a standard pruner, ropes and cord, ladders, a tar pot and brush, and also a wheelbarrow, to help in moving this mass of impendimenta about.

A general plan of what is going to be done must first be resolved upon; if possible, a complete picture of what the patient is going to look like after treatment should be evolved in the mind's eye before the work is commenced. It is probable that some of the upper branches will be dead or dying at their ends, and in any case it is best to start at the top of the tree. It is not sufficiently appreciated that pruning is in many cases the most certain way of producing vigour. Accordingly, the more urgent the need, the more drastic must be the treatment. It is, therefore, often advisable to shorten many of the branches upon a tree which is in a bad state of health by one-third or as much as one-half of their entire length. Where this is done it is essential that the cutting back should be to a healthy lateral branch; as before mentioned, it must be cleanly done, and, with the object of keeping out moisture, all wounds sufficiently large to be easily perceptible should be smeared over with tar. In cutting off a large branch it is as well to saw it off first at a little distance from the place of the final amputation. This is a precaution against the evils which would attend its splitting by reason of its weight, notably a tearing of the bark on the portion left. This is not, however, so likely to occur with an experienced man; there is a good deal of art in the handling of woodland tools, and one wrinkle in sawing off a branch is to make a cut on the under side first.

It may be objected that proceeding as is here suggested would result in producing a mutilated and ugly-looking tree. This may

be so, but what has to be must be, and certainly if the tree is not altogether too far gone to respond to treatment, the rapidity with which new branches are sent forth and comely appearance regained is truly marvellous.

It will be well to mention that the surface cultivation of the soil surrounding a valued old tree and the application of a suitable mulch are also highly important aids to its well-being. Any pruning of healthy large trees which is considered necessary must be conducted upon somewhat different lines. In such a case it is generally better to cut a large branch clean out than to shorten it, and the object is rather to operate so as to immediately improve the appearance of the tree. Trees of this description are not infrequently operated upon to their detriment. What is most characteristic about them is remorselessly destroyed to make them conform more precisely to the pruner's notion of what a tree should be, and it would often have been really better to leave well alone. In this connection it has been objected that what a gardener considers to be a well-formed tree is apt to be somewhat lacking in individuality; one kind looks too much like another, and the whole effect becomes perhaps more formal than is to be desired. This would be a most serious evil, and it should therefore be carefully guarded against.

So infinitely preferable is prevention to cure that the pruning of younger trees is a far more important matter than is the surgery of old ones. By far the most satisfactory results are obtained by commencing to prune at a very early age, and to produce a fine specimen in the shortest possible time it is essential that close attention should be paid to the well-being of the leading shoot and the regulation of the main branches. Pruning may be performed at any time of year except in spring, when the vigorous flow of sap renders it undesirable. Taking everything into account, the present (November) is perhaps the most suitable season.—(*By Alpha in the Field.*)

AFFORESTATION AT INVERLIEVER.

Under English law, the "afforestation" of any tract properly meant its removal from the operation of the ordinary common law and its subjection to special forest laws, which ceased to operate actively as regards additional areas after the Act for the Limitation of Forests was passed in 1641. But time rings changes even on purely technical terms, and so what is now meant by afforestation is simply the planting of timber. Of recent years especially, and with the hope that it may materially help to solve the momentous question of the unemployed, there have been strong expressions of opinion that some great national scheme of afforestation should be considered and commenced relative to the planting of such portions of our too abundant waste lands and poor grazing pastures as seem to hold out a reasonable prospect of profitable timber production upon business principles.

In the very nature of the present economic conditions obtaining generally, though with well-defined local variations in each of the four national portions of the kingdom, it is not to be expected that many private landowners, the majority of whom have only a life interest in closely-entailed estates, can have funds at their disposal for making large investments in timber plantations that can hardly, even in very favourable circumstances, begin to give any substantial return in the way of thinnings before about seventeen to twenty years have passed. And so, if any extensive work in the way of national afforestation is to take place at all, with the double object of increasing the amount of rural employment and of helping to provide useful home-grown supplies of the pitwood—certain to be still in great demand years hence, when our foreign imports of this class will probably be scarcer, more keenly competed for by other countries, and, consequently, far dearer in price than they now are—the whole matter practically resolves itself into a question of granting some substantial form of State aid to private landowners and county councils or other corporate bodies willing to plant timber, or else of the State itself acquiring poor waste lands suitable for planting, and then making such kinds of plantations as seem likely to be the most profitable and desirable in the national interests.

These are really by far the most important questions that have to be investigated and solved before any great progress can ever be made with extensive afforestation. But although their great importance was apparent to the Forestry Committee of 1902, it expressly declined to grapple with two such difficult and thorny questions. Greater courage and determination have now, however, been shown in Ireland, where a Departmental Committee appointed by the Board of Agriculture is sitting to consider and report upon these very points, along with others of a more special nature. In the Committee's report of 1902 it was, however, urged that with regard to Scotland a forest, that is to say, in this particular case a wooded tract, should be purchased by the State, to form a "demonstration area" for the use of Scottish students of forestry. As regular technical instruction in this branch of rural economy is being given at Edinburgh, Glasgow and St. Andrews, endeavours were at first made to try and find a suitable forest in some part of Scotland easily accessible from each of these educational centres. It was only when enquiries had been commenced with the view of acquiring such a demonstration forest that the practical difficulties in the way of carrying out the Committee's recommendation were realised. No suitable woodlands were available; and even if such had been procurable, their acquisition would have cost much more than the Treasury can spare at present for this particular purpose. So in making further enquiries the Commissioners of Woods and Forests, to whom this duty was assigned, had soon to abandon, not only the geographical central region of Scotland, but also in course of time to give up the hope of acquiring a suitable woodland tract. Then they began a long and careful search for an extensive area of poor pasture land and moor suitable for planting which would give a reasonable chance of growing timber crops profitably, so as to provide a much-needed object-lesson in this respect, and in course of time the desired demonstration area. It is, of course, impossible to attain the ideal; but within this last month a definite choice has been made by the purchase of Inverliever estate from Colonel Malcolm of Paltalloch, which seems to satisfy, better than any other estate examined with a view to its acquisition, the several

requirements and conditions that had to be kept in mind by the Commissioners of Woods and Forests, in whose charge the estate will now remain.

The Inverliever estate is situated in the mid-Argyll and Lorne districts of Argyllshire. It extends for about nine miles along the north-western shore of Loch Awe, and reaches back to a distance varying from about two to three miles. Inverliever House, a large shooting-box, is about fifteen miles distant from Lochgilphead and Ardrishaig on Loch Fyne, with which a good road connects it; and it is about the same distance from the Oban and Callender Railway which passes close to the north end of Loch Awe, the journey from Edinburgh or Glasgow to Loch Awe Station occupying about four hours. During the summer months excursion steam-boats ply on the lake, in connection with the railway. It will thus be seen that there are no direct and cheap communication lines whereby heavy timber could be at once placed upon any market and that there are no local wood-consuming industries in the vicinity, probably for the very simple reason that there are no large woodlands locally for the creation and maintenance for the timber supplies. Under present conditions timber, supposing marketable timber were available, would have either to be floated along the loch to the railway station, or conveyed by road for a distance of about ten miles to the Crinan Canal, or else taken to Loch Cragnish, an inlet of the sea about two miles from the southernmost part of the estate. But in course of time, no doubt, communications will have improved, before the timber crops about to be planted within the next few years attain marketable size, from thirty-five to fifty or sixty years hence.

The estate has an acreage of about 12,530 acres, the lands being held partly by the Crown and partly in feu of the Duke of Argyll, and it consists chiefly of rough hill pasture and moorland. But, besides Inverliever House, standing in a small park of about ten acres near where the little river Liever flows into Loch Awe, there are also six tenants' houses attached to sheep farms and eight cottages on different parts of the property, including keepers' cottages and a range of kennels, as the estate has hitherto been let

for shooting. Indeed, the grouse and black game-shooting is very fair, the annual bag being about 450 brace of grouse and 50 brace of black-game, though far the greater portions of the moors are not heather-clad, and are, therefore, not frequented by grouse. These keep chiefly to the lower grounds to the south-west of the estate—that portion most exposed to heavy rainstorms and therefore least suitable for planting. Fortunately, so far as concerns the successful establishment of young plantations, there are few rabbits, hares, or roe deer. The grazing lands are stocked with black-faced sheep. The lands bordering Loch Awe are lightly fringed with a spontaneous growth of birch, alder and ash, while there are 90 acres of enclosed plantations of larch, spruce, Scotch pine and Douglas fir, all about twenty years of age. These form three plantations, also contiguous to the lock, one at the north and two at the south end of the estate. The condition of the young timber is healthy, its rate of growth is excellent, and, wonderful to relate, the larch trees appear to show no signs of the cankerous fungous disease now almost ubiquitous throughout the British Isles. Judging from the fine old sycamores, silver firs and horse-chestnuts growing near Inverliever House, and elsewhere occasionally, the locality seems uncommonly well adapted for timber-growing, and this *primâ facie* opinion is strengthened by the fine growth shown by mature woods of larch and Scotch pine on the eastern side of Loch Awe.

The amount paid for the estate has not been officially disclosed though leakage of the news in Edinburgh has produced the statement that it is about £30,000, which is probably fairly near the mark. But until official data regarding the cost price, the gross income, burdens and net income have been made public, thus enabling the actual average value per acre as grazing lands, etc., and the number of years' purchase paid for their acquisition to be determined, it seems useless to try and estimate what the recent and present rental value of the land works out to. Most likely it will not be more than 1s. 6d. an acre for rough sheep pasture; and in such case land of this poor quality should furnish a good test for successful planting, that being just the great object-lesson wanted, upon which to base a larger scheme of national planting.

The river Liever runs north and south through the estate. It rises in the little Lochan a Bhruic, about a mile and a quarter from Inverliever, while this mountain tarn is itself fed by a stream trickling down from the summit of Tom an t'Saoir, half a mile further north, which rises to about 1,200 ft. high, while to the south of it another peak of 1,407 ft. elevation forms the culminating point of the estate. Almost every aspect and exposure is offered on the various hillsides. On the north side there are steep descents to Loch Avich, a small lake forming the extreme northern boundary, with an elevation of 320 ft., while the level of Loch Awe itself is only 116 ft. But on both sides of Glen Liever and on the hillsides between the Liever and Loch Awe the configuration is less abrupt, the slopes are gentler and the general situation is in most parts fairly well sheltered against the heavy gales from the south-west. For the most part the aspect is south-east, an aspect locally favourable for planting. The geological formation is the granite, gneiss and schist prevailing throughout the greater part of the Western Highlands. The soil is for the most part dry, so that comparatively little draining will be necessary, and the generally plantable quality of the land is shown by the abundant growth of bracken, which grows rank and high in some places. Here and there, however, large patches of deep moss and peat occur, which will require draining and soil-preparation before being fit for planting. Even now that the estate has been acquired, however, it is impossible to hurry on planting operations; and it is not intended to attempt that. But it is probable that the plantable area now in hand, free from any restrictions under the existing leases of the tenant farmers, will be planted at the rate of about 250 acres a year, so as in due course of time to have a really large forest area under a well considered scheme of management, and with a proper system of cropping portions in rotation, according to the modern method of scientific forestry. The bulk of the young woods about to be created will probably be larch and Scotch pine; but experiments will also be made with Douglas fir and other conifers, while several kinds of hard woods and soft woods will also be tried on the lower grounds.

A scheme of operations is already being drawn up with regard to the provision of a good net-work of roadways and inspection paths, the formation of nurseries and the planting of shelter-belts wherever necessary. There seems no doubt, therefore, that within the course of the next few years Inverliever will have something of further interest to show than the bare Highland hills which the tourist now views during his excursion up and down Loch Awe. —*(J. Nisbet in Country Life.)*

IRISH FORESTRY COMMISSION.

The Departmental Committee inquiring into the Irish Forestry question resumed its sittings on the 5th November. The chairman, Mr. T. P. Gill, presided.

The first witness examined was Mr. J. Nisbet, formerly in the Forestry Service of the Indian Government. He expressed the opinion that only one-fourth of the present plantations in Ireland were worked for profit, the rest being demesne woods of an ornamental character, or kept entirely for sport. The market for home-grown timber in Ireland was very bad indeed, because the local wood-consuming industries which formerly existed were no longer in existence, speaking generally, in the local districts.

The witness described the manner in which the profitable working of existing woods was handicapped, and went on to point out the valuable object-lesson in planting afforded by the Garryduff plantation in the famine years on Earl Fitzwilliam's estate. This aggregated 473 acres. It was badly hit by the storm of the 26th February 1903, and a lot of it was sold to an English timber merchant at the rate of £50 an acre. The buyer said it was the finest larch he had ever bought in Ireland. There were thousands of acres like that in county Wicklow, suitable for planting and worth little or nothing for any other purpose.

Mr. Forbes, who was present, mentioned that 200 acres of this plantation had recently been sold for £6,000.

The witness went on to emphasise the importance of the wood pulp industry. Spruce, for instance, could be grown in

damp localities largely. A small woodpulp industry could be "run" with from 2,500 to 3,000 acres of timber worked on a 50 years rotation, but it would not be possible to create the necessary supply of timber under 30 years.

In 1892, continued the witness, the wood imports to the United Kingdom were 191,000 tons, worth £981,000. Now the imports were 606,000 tons, worth £2,915,000. Even yet the industry was in its infancy, and anything Ireland could do in the way of growing timber for future use would be of enormous assistance to the British Empire.

Mr. Nisbet gave particulars as to "plantable" areas in the North Fermoy district about the Ballyhooley Hills, and in the vicinity of Mallow, Doneraile, Mullinavat, etc.

Witness roughly estimated the plantable land in Ireland at 750,000 acres. He believed there was no country in Europe which had lost so much as Ireland through Free Trade along with the famine.

The Commission adjourned.

At the sitting of the Departmental Committee on Irish Forestry held in Dublin on the 14th Novmeber, Mr. James A. Weale (Williams, Weale & Co.), timber merchants, of Liverpool, gave evidence. In the course of his remarks he stated that there were very grave reasons for believing that our supplies of foreign timber were steadily diminishing, and that unless we took measures to provide a supply of our own, within fifty years we should find ourselves in a precarious situation. He was unable to enforce his views by the production of figures relating to import and export, as the statistics of the Board of Trade were inadequate and unreliable. That Department exhibited a total absence of progress, and continued to laboriously compile its figures on a basis that was long since obsolete. He said the annual import of foreign timber into the United Kingdom was in the region of 20 million pounds, about half of this coming from Northern Europe and a third from North America. We could not hope to make ourselves entirely indepen-

dent of these sources of supply, but we could do something to relieve the scarcity so clearly foreshadowed. Each of the great producing countries had a growing internal consumption of their own which, as it increased, left less and less available for export to this country. In the case of America, her export of manufactured articles in 1860 amounted to 60 million dollars, in 1880 it had increased to 120 million dollars, while in 1900 it reached 400 million dollars. The development of these industries required increasing quantities of timber, and he did not believe there was a responsible American lumberman who would not agree that in another generation the United States would be importing timber instead of exporting. The incidence of this to the United Kingdom was obvious. It might be urged that values did not seem to appreciate in proportion to this reported growing scarcity. This might be explained by the fact that improved methods of manipulation had increased the output from the same amount of raw material. Twenty years ago the bulk of the timber imported was in the form of logs hewn square with the axe. To-day timber was imported ready sawn, and in many cases planed. A simple calculation would show that in squaring a log there was a waste of about 40 per cent of the timber. By exporting sawn boards this waste was reduced to less than 10 per cent, so that while in 1880 1,000 cubic feet yielded by Nature produced only 600 cubic feet, to-day 1,000 cubic feet produced 900 cubic feet, an increase of 50 per cent. Beyond this, ever so many bye-products of wood were being developed, which might be taken as an additional argument for planting. Woodpulp was an extensive industry, while artificial silk, yarn, horsehair, oxalic acid and acetic acid all made the intrinsic value of the tree greater than ever before. There was a growing recognition of the value of timber. This was evidenced by the exercise of more care to prevent waste in conversion, and also by methods of measurements becoming more stringent and defined. It was plain that the natural resources of timber in each of the great countries that supply us were being depleted, by the fact that ever so many woods were now common on the market that were unknown here twenty years ago, and were even neglected in their own country. The tupelo,

orham, cottonwood, hazel pine and satin walnut were examples. For the virtues of these there was little to be said, but when we saw the growing import of inferior woods and a diminishing import of better species, it showed that the inferior woods were filling the breach due to the scarcity of those which from their properties would always be preferred.

An important point to be noticed was that the average sizes of timber imported was declining, and the average quality deteriorating. Trees of exceptional size were scarce, and in some woods could not now be procured. All these facts showed that our supplies of foreign timber would surely decline as they failed in the countries producing them. Afforestation should be at once taken in hand. It was the function of forestry to look ahead, and it was the complexion of the timber trade that should foreshadow exactly what was to be done. Nature could not be hurried, but on the other hand "trees grew while man slept." It was not a matter for private enterprise alone, but called for the co-operation of the State. Our climate and situation was eminently suitable for the production of timbers with whose particular properties the world produced no serious competitors.

At the further sittings of the Departmental Committee of Enquiry into the subject of Irish Forestry, Mr. W. P. O'Neill, C.E., Engineer-in-Chief to the Midland Great Western Railway Co. (Ireland), gave remarkable evidence in favour of Irish-grown timber. He said the quantity of sleepers used on the whole of the railways in Ireland every year was about 700,000 or a million. He used on his railway alone between 60,000 and 100,000 sleepers a year, although the quantity varied a little from year to year. The timber his Company had been getting from abroad lately for sleepers had not been satisfactory, owing to the softness of the wood, and so they turned their attention to the question of whether they could get local timber. They then found that the Irish-grown timber was very excellent for the purpose, and they had been using it exclusively for sleepers for the past two years. The class of timber used for

sleepers included Scotch fir, larch and Spanish chestnut. Preserved beech was also very excellent for sleepers, its life being about 27 or 30 years. Very large quantities of this particular timber were used in Germany and France. Larch was very fine for the purpose of sleepers, and lasted about 20 years even without preservation. The softness of the foreign timber was due to the depletion of the forests. The average life of American timber was about six or eight years. The Irish timber, witness's company had been using lately, was much superior to the softwood they had been getting from abroad, and just as good as the foreign timber they used before it, became soft. Larch and Scotch fir were cheaper than beech, which cost about 3s. 6d. per sleeper. Witness said he experienced considerable difficulty in buying Irish-grown timber, because the timber trade was not systematical in Ireland. Instead of entering into a big contract as would be the case with the foreign timber, he had to "switch it off" here and there. He thought it was a great pity that there was not a more organised plan with regard to the timber trade in Ireland. If the trade was better organised and the timber stored in large places, it could be better seasoned and properly treated. Witness mentioned that he had himself planted twenty thousand trees on various parts of the line in Galway and Clifden. Some larch trees which were planted about ten or twelve years ago were doing extremely well. There was no general attempt in the country to keep up the supply of timber.

In America they are going in very much for concrete sleepers with wood blocks. However there has been no material used for sleepers up to the present that has given such satisfactory results as timber. It was a curious fact that a large number of Irish sleepers went to Scotland.

Mr. Montgomery stated the last time he saw Irish sleepers abroad was in the heart of the Black Forest.—(Laughter.)

Witness mentioned amongst the timbers suitable for sleepers which could be grown in Ireland, Scotch fir, silver fir, larch, oak, beech and Spanish chestnut.—(*Timber Trades Journal.*)

THE LATEST RUBBER SUBSTITUTE.

Harry B. Cox, a chemist of No. 77, Sigourney Street, Hartford, Connecticut, has developed what he terms a substitute for india-rubber and has named it "Halcox." This is referred to as capable of being compounded as readily as natural rubber, and of being vulcanised with even greater facility. Mr. Cox says that it has the advantage over rubber that it may be produced in any required consistency—liquid, plastic, or stiffer if required—and that it can be held in a state as liquid as water, but nothing will be evaporated or lost as is the case where rubber is reduced to a liquid form by the use of naphtha. Mr. Cox informs the *India Rubber World:* "The product will soon be a regular market commodity, manufactured and backed by a prominent rubber company."—(*India Rubber World.*)

USE OF DEAD TIMBER.

The general belief that dead timber is unsuitable for use in any construction requiring strength is said to be unfounded, observes the *Engineering and Mining Journal.* This subject has recently been reported upon by Gifford Pinchot, chief of the U. S. Forest Service. Of the several classes of dead timber it appears that fire-killed timber is the only variety of any considerable importance. It is estimated that there are approximately 13,000,000 acres of this timber, having approximately 500,000,000 feet board measure. The principal defect of fire-killed timber is check, which appears soon after the death of the tree, but apparently does not greatly increase later. The principal defect of dead timber is check and this may largely be minimised by using the timber in round form for mine and coal props, telephone poles, fence posts, and the like. This variety of timber is especially suitable in mines because it is perfectly seasoned and is light. It is estimated that the mines of Leadville, Colo., use each month some 350,000 feet, board measure, of dead timber. There are also many other large mining camps that use it in wholesale quantities and in these camps it is decidedly preferred to green timber. Another

decided advantage which dead timber has is that it is an excellent condition for preservative treatment, as the moisture has evaporated from the wood, so there is no watery sap to act as a mechanical barrier to the entrance of the preservative.—(*Indian Engineering.*)

TIMBER SUPPLIES OF THE FUTURE.

At the first Forestry Congress, held at Washington about a year ago, President Roosevelt said: "If the present rate of forest destruction is allowed to continue, with nothing to offset it, a timber famine in the future is inevitable." Never were more truthful words uttered; and if this is the case with the United States, it may be well to consider what is our own position, as by far the largest importers of timber—larger, indeed, than all the rest of Europe put together. When we consider, therefore, that the total area of woodlands in this country is only a little over 3,000,000 acres, that fully 15,000,000 acres of waste land exist, and that we annually import over 10,000,000 tons of timber at a cost of about £30,000,000, the necessity for an increased area of woodlands will be apparent to all, and the more so as a dearth of timber is imminent, and outside supplies are being rapidly consumed, while our home demands are ever on the increase. Taken as a whole, Europe has not enough timber to meet her demands, about 4,000,000 tons in excess of what she produces being annually required, and stringent laws have been passed regulating the output. This is the case with Norway, Sweden, Finland, and Russia. The Canadian forests and those of the United States are both nearly exhausted, and by a competent judge it has been said that in fifteen years little or no timber will be left if depletion goes on in these countries as at present. But the worst is that there are no forests to fall back upon, for the timber of those of Africa and Australia are unsuited generally to our wants. Indian teak is certainly useful, and the vast forest lands of Russian Siberia, which contain much useful timber, are too inaccessible, while China and Japan require at present more timber than they produce. Quoting again from President Roosevelt's speech, he said, "Remember that you can prevent such

a famine occurring by wise action taken in time; but once the famine occurs there is no possible way of hurrying the growth of the trees necessary to relieve it." For the past five and twenty years I have not failed to urge on the State and private owners of woodlands the pressing necessity of planting up some at least of the waste and unprofitable lands of our country in order to provide timber for the future and leave us less dependent on the gradually dwindling supplies that are annually sent us from abroad. England, being so to speak, a residential country, the retention of a certain amount of heath, mountain, and commons land for the purpose of deer forests, grouse moors, game coverts, and golfing links is imperative and will considerably reduce the amount of land available for afforesting purposes. But I think that I am well within bounds in allotting out of the 15,000,000 acres of waste lands 1,000,000 acres to afforesting and 14,000,000 to game preserves and golfing. Having personally explored much of the mountain and heath lands in England and Scotland and some of the vast tracts of bog-land in Ireland, which alone extend to fully 1⅛ million acres, I have carefully computed that of land up to 1,200 ft., where timber would grow perfectly well, about 9,000,000 acres are available for afforesting purposes. As far as I have been able to find out, the average rental of such ground would be a trifle under 3s. per acre, while, on the other hand, I am quite convinced that any land which does not bring in at least three times that amount for grazing or agricultural purposes would be more profitably employed in carrying a crop of timber. It is, perhaps, unfortunate that much of these waste lands are private property, the owners of which, even could they afford it, have little inclination to sink, for a period of, say, twenty-five years, the necessary capital required to be expended on the formation of woods and plantations. Under such conditions, the question naturally arises, what is the most feasible way to overcome the difficulty? In answer, and without the slightest hesitation, I would say that the State should acquire and plant suitable waste lands at the rate of 40,000 acres annually for a period of twenty-five years. Such lands could in England, Scotland, Wales, and Ireland be gradually and cheaply acquired by the State with a change of proprietors, and in

Ireland vast tracts of bog-land would be willingly handed over to the Government at the present moment at a small sum per acre. Quite recently in Wales 7,412 acres of upland, described as "rough grazing and sheep walk," was sold by public auction for £15,670, or at the low rate of £2-2-3 per acre. The land was peculiarly suited for the growth of larch, as the highly remunerative plantations adjoining clearly proved. Again, the Crown quite recently purchased 12,500 acres of land in Scotland at £2 per acre. But many similar cases could be given, so that the excuse of no available land is not tenable. Personally, I have little faith in the State advancing money to landed proprietors towards afforesting, or in municipalities coming to the front as planters of woodlands. The State and the State only can readily acquire the needed land in sufficient quantity and on the best terms, and I am fully convinced that plantations formed under this supervision will, in an economic sense at least, be far ahead of those planted either by private persons or public bodies. After careful computation I do not hesitate to say that the area of plantations in the United Kingdom could at once be doubled by the planting of waste lands which at present do not bring in over 2s. per acre of rent annually, with infinite benefit to the country generally and a vast increase in the value of the land both to the owner and farmer who cultivates it. I have already suggested that, altogether, 1,000,000 acres should be planted over a period of 25 years at the rate of 40,000 acres per year, which would be an outlay of about £290,000 annually—a small sum, it will be admitted, when compared with the £25,000,000 yearly expended by this country on supplies brought from abroad.

The financial returns from planting poor waste lands have been given over and over again, and need not be repeated. Suffice it to say that at the very least £1 per acre per annum can be counted upon up to the age of from 60 to 100 years, according to the particular kind of timber under cultivation, with a standing crop at the final clearance valued at from £50 to £150 per acre.—(*B. A. D. Webster in the Timber Trades Journal.*)

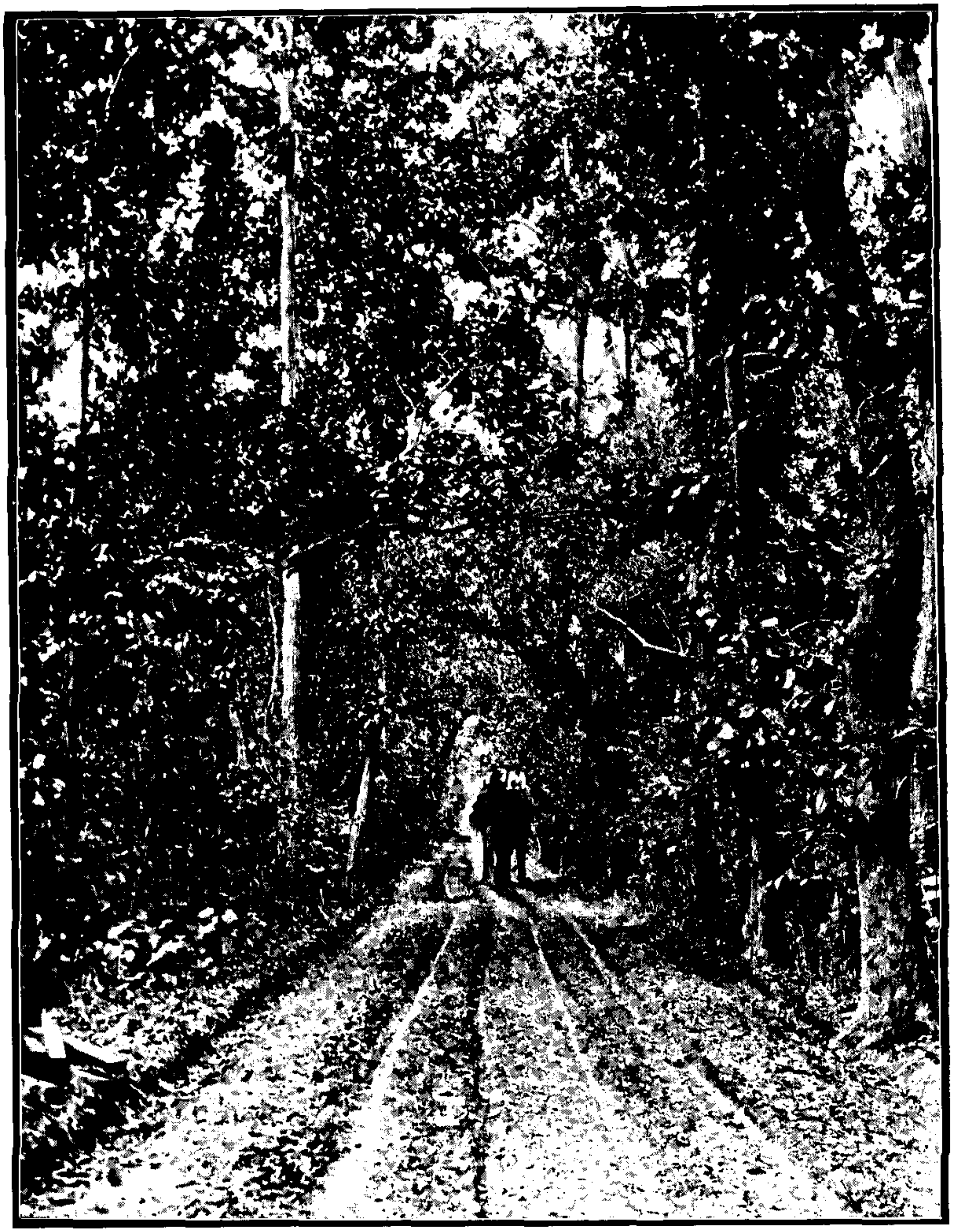


Photo.-Mech. Dept., Thomason College, Roorkee. Photo. by H. Hastings.

A 15′ road in the Sal Forests, near Dudua, Kheri Division, U. P.

VOLUME XXXIV NUMBER 3

INDIAN FORESTER

MARCH, 1908.

FORESTRY AND IRRIGATION.

In the November Number we pointed out some of the benefits which suitably situated forests confer on agriculture and in the January Number we tried to show the enormous advantage of forests in increasing and fostering the supply of water. This month we will continue the subject with reference to the assistance that irrigation can derive from suitably situated forests. The subject is by no means new. We have repeatedly drawn attention to it in the pages of this magazine. Other Journals also often refer to the subject. Indeed in all countries where scientific forestry is in being, the fundamental principles of the beneficial influence of forests on agriculture by the improvement they cause in climate, rainfall, water supply and irrigation are well known and are frequently expounded.

The editorial in the number of the *Indian Forester* for September 1906, drew attention to an article entitled "Forests and Rainfall" which appeared in the *Pioneer* of September 15th, 1906. This article specially pointed out the anomaly that the Irrigation Commission entirely failed to make any enquiries concerning

forests in spite of the fact that their influence is well known to be one of the principal factors in regulating the supply of water for irrigation, on which such enormous expenditure is being incurred. Yet it may safely be stated that the volume of water in rivers and lakes is in proportion to the area and density of the forests in their neighbourhood and covering their sources. We pointed out in the January Number how forests intercepted the rainfall and only allowed the surplus water to drain gradually into the rivers instead of rushing down to form floods as is the case where there are no forests. Forests in fact, tend to make the volume of water in rivers, more equable all the year round, that is, *they not only prevent floods but they insure a supply* of water in the drier seasons, just when it is most wanted. We have too, repeatedly pointed out how forests tend to increase the rainfall. Mr. Pearson's translation of M. Henry's article in the February Number shows how this influence in this matter is much greater than it was generally supposed to be.

The subject is now receiving a great deal of attention in America, where in many parts the effects of the destruction of forests are now most serious. How important this question is may be judged from President Roosevelt's speech at Memphis on the 4th of October 1907. From it we quote the following:—

"The National Forest policy inaugurated primarily to avert or mitigate the timber famine which is now beginning to be felt, has been effective also in securing partial control of floods by retarding the run-off and checking the erosion of the higher slopes within the National Forests. Still the loss from soil-wash is enormous. It is computed that one-fifth of a cubic mile in volume, or one billion tons in weight, of the richest soil matter of the United States is annually gathered in storm rivulets, washed into the rivers and borne into the sea. The loss to the former is in effect a tax greater than all other land taxes combined and one yielding absolutely no return."

"It is clear beyond peradventure that our natural resources have been and are still being abused; that continued abuse will destroy them, and that we have at last reached the forks of the

road. We are face to face with the great fact that the whole future of the nation is directly at stake in the momentous decision which is forced upon us. Shall we continue the waste and destruction of our natural resources, or shall we conserve them? There is no other question of equal gravity now before the Nation."

Our readers have doubtless noted with satisfaction the news that the subject is now being taken up in India. "We understand," says *Indian Engineering*, "that the Secretary of State has again addressed the Government of India on the subject of the influence of forests on water supply. It will be remembered that we mentioned in our columns some short time ago that the Supreme Government in India had, at the request of the Secretary of State, invited the attention of the Local Governments and Administrations to the matter, and had ordered a careful enquiry into the question. The subject is one of the greatest importance to India, and more especially to the agricultural population, whose prosperity depends to a large extent on the distribution of the available moisture, not only in the form of rainfall, but of the surface flow of streams and rivers and of the underground flow from which is drawn the supply of water in wells. The question affords a wide scope for enquiry and there will probably be some difficulty in dealing with it in all its aspects. The enquiry ordered by the Government of India embraces, we believe, the following matters:—(1) Is there any reason to believe, that during the last half century the amount and distribution of the rainfall over large tracts of country has altered permanently for the better or for the worse? (2) Has there been any permanent change in the level of the underground water table? (3) Has the flow of rivers and streams become less equable than before, that is, are floods now shorter in duration and more violent and destructive and do the streams dry up more quickly in the dry season? And has this resulted in serious injury to the interests of cultivation or to other interests? (4) Where such a change has taken place, is there any reason to connect it with the destruction of forest vegetation in the catchment areas of the rivers and streams? (5) What evidence is there that the catchment areas have been denuded to any serious extent during the

last half century? (6) What steps have been taken in the Province to check the destruction of forest vegetation, and what has been the effect of such measures in preventing the denudation of catchment areas and in maintaining an equable distribution of the available moisture? (7) Is there sufficient ground for taking further measures to check the destruction of forests or to re-forest areas which have been denuded of their forest growth, and, if so, what measures are recommended?"

We trust that a strong commission will be formed to conduct this enquiry in such a way as to obtain all the evidence that is available on the subject. It is certain that, if those who can give information on the subject are encouraged to come forward, a mass of information will be collected. There is, however, a further point not mentioned above which we would suggest, should be enquired into at the same time and that is the silt carried down by rivers. There is no doubt that silt may at times be of use, and that greater use still could be made of it, as pointed out by Sir Edward Buck in his instructive report on the Control and Utilization of Rivers. On the other hand, there is no doubt also that the greater proportion of silt is carried down to the sea, and represents an annual loss to the country of an enormous quantity of extremely fertile soil. We do not maintain that forests would prevent this loss entirely, but we believe that suitably situated forests would reduce this loss to a minimum. The greater part of the erosion by rivers occurs during times of flood; if forests can help towards preventing floods, they will at the same time help to check the loss of a great deal of fertile soil which in the aggregate is a severe drain on the country. In many parts of the country the irrigation works consist to a large extent of tanks for storing water. Silt in such cases often does great harm by causing the tanks to silt up. The maintenance of forests in the catchment areas would prevent this to a very great extent.

SCIENTIFIC PAPERS.

EDUCATION AND RESEARCH IN INDIA.

(OCNTRIBUTED).

An important article on research work in India and its bearing upon education in general and more particularly upon education as delivered in the Colleges throughout the country appeared in the *Pioneer* of October last. In the London Science Weekly, *Nature*, which represents and voices the opinions held by the greatest scientists of the day at Home, the *Pioneer* article has met with the warmest reception in some paragraphs, which are worthy of the most serious consideration among those who have the interests of the country at large at heart: for education must be considered one of the greatest of those interests. *Nature*, whilst approving and cordially agreeing with the opinions expressed by the *Pioneer's* correspondent, goes further and offers some kindly advice to the Government and University and Collegiate Institutions of this country. It will be necessary here to shortly recapitulate the most important points in the *Pioneer* article. It was pointed out that, although the first excitement created by Lord Curzon's measures of University Reform had died away, it could not be overlooked that the work, merely initiated by new Acts and sets of regulations, had yet to be actually done and that rather momentous issues depended upon the spirit in which it was done. Attention was drawn to the report of the educational officer specially deputed to note on the efficiency of the professorial staff of the Presidency College, Calcutta. In this memorandum it was maintained that if the college was to satisfy the new demands on teaching, the Science professors would have to at once largely curtail the research work in which they had been indulging in the past. A second officer, closely connected with the college, was found, who not only endorsed this extraordinary idea, made it must be remembered by an officer of the *Educational* Department of India, but went further and informed the world that "research in the Presidency College has of late

become something of a bogey, even demonstrators and assistants being involved in researches." This he assured his readers had led to "neglect of pure teaching" and the first measure demanded by the new era of higher education was that "the entire staff, from the senior professors downwards, should put aside their researches which, as far as the interests of the college were concerned, were not only useless but positively injurious."

Let us turn and glance at the opinions held by some of the cleverest brains in the Empire—men who move with the times and endeavour to ascertain what is needful to the younger generations of an ever-growing Empire and an ever-progressive world. *Nature* says "The battle between those who believe the sole duty of our professors in universities, colleges and other high educational institutions is to teach, and the best professor one who devotes the whole of his time to teaching, and those who believe that the highest and the most fertile kind of teaching is that carried on by a professor who is an investigator as well as a teacher, has been fought out on many occasions and in many places.

Fortunately the latter view in late years has largely prevailed over the former, though the battle has still to be actively carried on in many places. The universities of Europe, at all events those which are the most progressive and of greatest importance, have accepted the fact that in the selection of their professors they must now take only such men as have given distinct proof of capacity for original work in one or other of the great departments of knowledge, and who may be expected to continue their original researches at every possible opportunity.

Unfortunately, in England this spirit has not always been acted on, and the condition of a good many of the institutions devoted to the highest culture is, in the matter of research, most unsatisfactory, and compares most unfavourably with institutions of similar grade on the Continent.

Nor, indeed, is this lack of original work in England confined to what may be called centres of the highest intellectual activity, but it largely pervades throughout educational and technical institutions of all grades, and it is stated that in many cases where the

management of such institutions is in the hands of committees, whose members are distinguished mainly by their success in trade, original research on the part of the staff is practically barred, and, if a professor or teacher is known to be an enthusiastic investigator, he is at once considered to be one who is not doing full justice to the students entrusted to his charge.

It is to be hoped that such instances will become more and more rare as the proper functions of a teacher are better understood, and it is for our universities, and for all educational institutions more or less controlled or influenced by Government, to take the lead in this matter and to insist on the inseparability of research from the highest branches of teaching.

An opportunity of taking such a stand and of doing an almost incalculable amount of good to the higher teaching of a country now appears to lie in the hands of the Indian Government. For a good many years India may be said to have been suffering from an educational unrest, for it was understood by all those who had studied the subject that Indian education had been working on unfortunate lines. Lord Curzon, during the time he was Viceroy, was the first who boldly faced a very difficult problem, and under his direction Indian education was placed upon a much more satisfactory basis. The changes brought about by Lord Curzon's action were very numerous; primary education was largely extended and made more practical; female education was fostered in every possible way, secondary education was also improved, and, lastly, university education was dealt with. Under a new Indian University Act a complete set of new regulations has been prepared, and speaking generally of these regulations it may be said that they aim at, first, the influencing of the characters of the students in the colleges and high schools, and, secondly, at securing a practical rather than a book knowledge of the subjects dealt with.

It may also be mentioned that, in cases where a science is being studied, the regulations require each student to have had personal practical instruction and so far as possible to be practically examined. In the case of the higher degrees, such as D.Lit. and D.Sc., original work on the part of the student is an essential

preliminary to his getting the degree, and even with lower degrees, provision is made for any one showing any practical originality to be excused a certain part of the usual theoretical book work.

It is, of course, understood that these regulations will require a stronger professorial staff to man the colleges of the universities than if merely theoretical instruction had to be given. A good many of the colleges attached to the Indian universities, indeed all the largest and most important, are directly managed by the Indian Government, and it is on the action of this body that, to a large extent, the effective working of the new Indian University Act will depend. The colleges must be dealt with liberally in the matter of staff, or the Act will be inoperative, for if Government colleges, with the resources of Government behind them, do not take the lead, it is useless to expect any others to work up to the desired standard."

These remarks would seem to be particularly applicable to the educational needs of the Indian Forest Service so far, that is, as the education of the recruit for all the branches of the service is concerned. What we require is that the officers who undertake the education of the men who are to fill the ranks of the service, we have said in all grades, but most certainly so in those of the Imperial and Provincial branches, should not only be themselves experts in their various lines of work but that they should employ all the time not actually devoted to the tuitional part of their duties in research work, and research work undertaken with the direct object of elucidating and furthering the scientific and economic problems of the Department. For years past it has been held that the Imperial man should be trained at Home both in the theory and practice of forestry. Admitting that this was necessary, or shall we say inevitable, in the past, can it be held that it is either inevitable or necessary *now?* Can we hold that the Imperial man has a training one-half as good for the work he has to face in the future as is obtained by the Continental Forest Recruit? The latter is taught, as we all know, by specialists in their own lines and *taught in the forests in which his life's work will be passed.* What is the result? He becomes an excellent *Forester*, giving to the term

its proper significance. Can we maintain that this same teaching has turned out men who have become *Indian Foresters* in the sense we are using the term? The past history of the service answers the question. The pages of the *Indian Forester* do the same. We have remained European Continental Foresters with our hands full of administrative work and no efforts have yet been made, so far as the education of the Imperial recruit is concerned, to make us anything else. And how can it be otherwise? With the known exceptions, the experts who teach the Imperial recruit know nothing about an Indian Forest or Indian Forestry and no one at present concerned with the education has any personal acquaintance with the present position of the Department and the tremendous development which has taken place in it, in the last few years. Before their arrival in India the Imperial Probationers cannot expect to profit by the personal precept or work of a single expert of the Department and, as matters are at present, few of them can hope to do so after arrival. No research work of use to the Department in India has been done at Home during the past decade, in spite of the fact that whole-time men were retained by the Secretary of State for the instruction of the probationers. Being entirely unacquainted, for the most part, with Indian Forestry and the needs of the Department they have left untouched fields in which there is an immense amount of work to be done,—fields which might at least have been opened out years ago, had it been made a *sine qua non* that the teachers of the Forest Probationers should consider that there were higher aims and wider fields in their path of duty outside of 'pure teaching.'

There would seem to be little use in delivering expert courses to the recruits for the Provincial Service in India if the Imperial men, the men who are to mould and guide the destinies of the Department in India in the future, are to be given merely theoretical instruction combined with those Continental object lessons which have become inefficient and obsolete and which are now stunting the originality and breadth of view of the Department in India. The time has arrived, and in our opinion arrived some time back, when the Imperial men require to be given their instruction

by whole-time Indian Forest Experts in all the important branches of Forest Science, and until this is recognised the education of the Imperial Service Recruit will remain in certain important essentials, what it is at present, strikingly inefficient. If those who have given this matter serious attention, can point out the ways in which the education of the Imperial Service in the past has led towards real progress in the Department, as a whole, in India, we shall be glad to hear them, for in our opinion the endeavour to inculcate the principles of Indian Forestry through Continental object lessons has consistently resulted in impeding that progress in research which could have legitimately been looked for now that the Department has the major portion of its Forest Estate under a fairly ordered management.

Education uncombined with research is not education as understood now-a-days ; and in a specialised Department such as the Forests, the teachers of the men who are to fill its ranks should be highly efficient experts, fully capable of combining with their tuitional duties research work of the most advanced type and degree. Encourage your expert to undertake such work, and require it of him, and there will be little doubt that he, on his own initiative, will encourage and stimulate his students to go in for research also. This is real education and the ideal at which the Department should aim, for in it alone will be found the path to real efficiency throughout all ranks.

FORESTS (IN JAPAN).

EXTRACT FROM A NOTE ON AGRICULTURE IN JAPAN, BY SIR F. A. NICHOLSON, K.C.I.E., I.C.S. (RETIRED.)

116. * *One of the most remarkable and agriculturally important* features of Japan is its forests which cover more than ·59 per cent of the whole area of the empire; from time

* It is, of course, not intended here to describe Japanese forests and forestry, but nly so much as directly affects the cultivator and affords lessons for Madras specially regards private woodlands.

immemorial stringent rules have been framed, and to some extent enforced, especially in the last three centuries, by the local barons and princes for the preservation of the woods and forests, the protection of the head-waters of rivers, the hindering of land-slips and avalanches, the production of timber and firewood, and the conservation of valuable trees, being especially aimed at; records were duly kept and rotation systems adopted though apparently there was a good deal of negligence in conservation. There was also a period of reckless felling in the disturbed period between the Shogunate and the full establishment of Imperial power, and even the prudent Japanese could not refrain from the entire denudation of woods near valuable markets as I have personally seen; this, however, was stopped in a few years and a regular Forest policy and Forest department have been established. Most of the forests are of course on the hills and mountains, not in the fertile valleys which are given over to arable cultivation, but, as will be presently seen, there is a great deal of wood growth included as "forests" which is scattered in small blocks (*paullum sylvæ*) among the upland cultivation, and which should rather be called topes or groves, copses, spinneys, or plantations.

117. The total area of forests, excluding 4·2 million acres of "wild" land, is 52·4 million acres of which 2·2 million are "reserved" and 50·2 million are "utilization" forests. The gross area is divided into State, Crown and Private forests of 30·4, 3·5, and 18·5 million ácres, respectively. While the State and Crown forests are of great general importance to agriculture, only private forests can be dealt with, and but briefly, in this note, for it is from these private forests chiefly that the cultivators draw large stores of herbage and vegetable matter as green manure for their fields, wood for implements, and fuel and timber and firewood for sale; while eleven-thirteenths of the State forests are in thinly populated Hokkaido and in the northern Provinces of the main island, the private forests are scattered fairly evenly over the country according to the population, and over the several villages.

118. The nature of these private "forests" may be judged from the fact that while aggregating 18·5 million acres they are held

in just 21 million plots, so that each "forest" averages 0·88 acre; some are larger, some smaller; hence, as stated above, they are rather the wooded plots attached to the various holdings, though often distant and probably forming continuous woods in many cases. Travelling by railway or by road in the more undulating and hilly tracts these woods and groves may be everywhere seen, sometimes as young plantations just set out, sometimes as grown woods, sometimes just felled, sometimes mere scrub-jungle.

119. Of the 18·5 million acres of "private" or rather "people's" forests, just 76 per cent, or 14 million acres,* belong to private persons, the remainder, except 2 per cent, belonging to the communes which in Japan, as in Continental Europe, are political corporations, self-governing, and possessing property. Agriculture is perhaps equally benefited by both classes of forest, for while the strictly private forests benefit the individual agriculturist, the communal woods benefit them as a community and are probably managed with more foresight than the private ones. Apart from the manurial and other domestic benefits these people's woodlands give an immense profit to the owners; in 1905 the enormous quantity of above 203 million cubic feet of timber and above 16 million stacks (3′ × 6′ × 6′) or cords of firewood (each cord weighing $1\frac{1}{8}$ tons if dry and $1\frac{1}{2}$ green) valued at about 43·5 and 35·8 million rupees respectively, were cut from these *private* lands, or more than five times the amount of timber and fifteen times the amount of firewood felled in the much larger State and Crown forests; the yield per acre is thus 11 c. ft. of timber and 1·2 tons of firewood. Besides this, 4·7 million bundles (each of a size to be tied with a 3-foot cord) of bamboos were cut, valued at 2·3 million rupees. Whether this means overfelling or not is not stated, but it was said in 1904 that with few exceptions private forests are left to nature and that they are in a very impoverished condition, having been managed without sound principles, and that even since the Restoration (1867) there has been reckless felling of woods owned by private

* 85 per cent or 15·7 million acres is elsewhere stated as the area belonging to private individuals.

persons; the recent demand is so great for building, fuel, paper pulp, matches, etc., that such felling is to be anticipated; many areas, it is said, have little timber growth and only yield vegetation for manure; on the other hand, it is elsewhere stated that private forests in *some* places are worked as a business with great care and yield large profits. But there is both ocular evidence and that of the statistical records to show that there is also *much* replanting; personal observation showed thousands of acres of young plantations near and in villages, and the latest (1905-06) annual report for Agriculture shows that 317 million seedlings and young trees were planted in 1905 on 260,000 acres of people's land, and it is on official record that in two recent years above a million acres of *communal* land alone were replanted with 801 million seedlings and young trees. Since it must be difficult to enumerate all petty private planting, these statistics of replanting are minima; they are none the less striking. The trees planted are mostly conifers such as the well known *Cryptomeria japonica* (162·5 millions) and others, but more valuable trees were also largely planted such as the camphor (1·34 millions), the chestnut (1·38 millions); the figures are for 1905 alone. This planting represents the trees grown on the woodlands only, and not the mulberry, lacquer, and vegetable wax trees, etc., grown on the arable fields or their borders.

120. These woodland blocks intermingle with the upland cultivation; often they are plots too steep or rocky, etc., to be terraced, or else are deliberately maintained as woods; sometimes they are wild scrub, sometimes carefully planted topes of varieties of pine, etc. In "Japan in the 20th Century" it is stated that they are largely regarded as places for getting "fuel and fertilisers in the shape of grasses and herbage so that even at present there is no small number of woodlands *containing no growing stock* and principally used by the people for procuring manure grasses and herbage from." Another writer (Dr. Nagai) speaks of the large number of "*prairies naturelles*" the produce of which is used by the ryot in preparing his compost. To judge by their valuation for assessment they do not *naturally* contain

much timber of value; the total capital valuation for assessment of the 18·5 million acres was only Rs. 362 lakhs or Rs. 2 per acre; *in 1904-05 the 32,500 acres of State forest sold for cultivation*, were valued at about Rs. 4 per acre. The assessment *plus* local rates on the whole 18·5 million acres in 1906 was only Rs. 33·3 lakhs or about 3 annas per acre, and this was at war rates; the original or normal rate would be little above one anna, State assessment alone being perhaps 9 pies per acre. These local woodlands, held by each little farmer in petty areas close to his house or farm and at nominal rates are of great advantage to him; taking the land individually held at 14 million acres, there is about 1·1 acre of "woodland" for every acre of arable holding; taking communal and individual together, there are nearly 1·5 acres of wood per acre of arable the whole of which is held within the villages themselves.* Whatever the

* In this Presidency the only counterparts to the Japanese village woodlands are the petty village reserves supervised and annually rented out by the Forest Department, a variety of purambokes not so supervised and mostly bare, such as village sites, cattlestands, etc., and the village assessed waste which being liable to absorption into arable is simply cleared of every blade and stick that can be taken off it; in large tracts, mereover, there is practically no waste at all, as in many parts of Coimbatore, black soil tracts, etc. On the other hand, the holdings of the ryots in this Presidency are larger than in Japan and one-fifth of the ryots' holdings—less in the Tamil districts, more in the Telugu districts except Bellary, Kurnool and Ganjam—are *annually left fallow: both nature and good culture* ***demand*** *that a portion of these lands* shall be planted with trees of agricultural, industrial, and dietetic value. It is the lower class of land which would be most benefited by trees either as a rotation crop or as a permanency, and these are the low-assessed areas; there are several millions of acres in holding assessed at rates not exceeding 8 annas, and much of it at half that rate. It is impossible to believe that this assessment really stands in the way of tree planting; *one acre* at 6 annas will cost the ryot for assessment less than Rs. 4 spread over 10 years, and while the field itself will be vastly improved in texture, nitrogen contents, etc., by the action of the trees, the value of the timber, firewood and incidental advantages will far outweigh any such cost, and its annual produce in manurial or fodder leaves, etc., will so benefit the remaining lands that the reduced arable area will produce larger and, what is even more important, more regular crops, better able, through the improved texture of the land, to withstand seasonal stress; the mere cattle manure saved as fuel by such plantations will more than repay the cost of planting.

If it be desired, however, to encourage tree planting, it is open to Government to enlarge the tope cowle rules (S.O. 19) by allowing land in holding or that may be taken up from existing waste irrespective of the period during which it has been waste, to be

past history of these woodlands the present owners seem to be waking up to their value as shown above in the replanting statistics; replanting is in its infancy but the statistical results are already

cultivated with trees at a nominal or *Nil* assessment for 10 years or for 5 years when the "trees" are only manurial shrubs. Last year Government relinquished the village service cess of 26 lakhs, which represented (part of) the amount immemorially paid by ryots for village services rendered, a gift for which the general tax-payer must now pay instead of the ryot who gets the services. Had this sum been retained, it would have been easy to grant the above privilege or to insist on ryots cultivating a portion of their holdings with trees on condition of receiving a rebate of assessment; 26 lakhs represents the assessment annually on 5·2 million acres at 8 annas per acre. Or the amount of this cess might have been annually remitted to each village on condition of a proportionate amount of tree planting. The Japanese, notwithstanding heavy and heavier taxation, do not remit taxation so much as spend wisely with the certainty that much greater benefits will accrue than had they remitted a few annas per head; their heavy expenditure on Fisheries, on Agriculture, and on Industries is only possible because they tax in order to spend heavily in directions in which State help or initiative is necessary. The authorities might also establish nurseries at various large weekly markets—which in Coimbatore used to, and probably still do, yield a rental income more than sufficient for actual market needs—for the gratuitous distribution of seedlings of good quality, as in the Japanese Agricultural Stations; see footnote to paragraph 121 *infra*. This would, *experto crede*, immensely popularise and stimulate fruit tree planting. A fiscal stimulus to tree planting would be the promise, coupled with an entry of the promise in the pattah, that, up to a certain area or proportion of the holding land planted with trees should, in no case, be liable to enhanced assessment at the next subsequent Settlement. A very great increase in tree growth is *not* a mere individual question; it is national or State; increased rainfall and climatic amelioration, the supply of timber, fuel, fruit, fodder, leaves, the consequent diversion of manure to its proper use in the soil, the positive increase and betterment of the manure itself through the produce of the trees, the improvement of the surface from the sub-soil chemically and physically, the consequent increase in crop and diminution of liability to damage through drought, improvement of the soil of the planted field, the provision of a crop in timber, etc., which is not liable to destruction by drought; these and other advantages which mean greater agricultural stability and decrease of liability to seasonal stress, are national necessities.

As regards the ryots the very trees that would most benefit the land are those which grow most easily or even spontaneously, *viz.*, the Leguminosae, such as the Acacias and Albizzias, or shrubs such as the Tephrosia purpurea so greatly in demand for green manure. In many places little besides protective *enclosure* suffices, with a rough ploughing and dropping of the seeds or, as in Tinnevelly, by feeding goats on the land with the pods of the trees desired; in Japan the method of nurseries is found the most successful and any ryot could raise in his backyard a nursery sufficient for an acre, absolutely without cost, of any desired tree. The subject will be developed in "Suggestions" in a second edition of this Note.

somewhat startling, and the most superficial observation shows large areas of new plantations, principally of the various conifers; the statistics also show many more valuable trees such as 1·4 million camphor trees in 1905 alone on private woodlands.

121. This replanting of woodlands is a marked feature of Japanese petty forestry (it is also largely carried out in the State forests) and is largely due to the foresight of the authorities. So far back as 1876 Government attempted to induce private persons to replant State forests in areas where there had been reckless deforestation, by offering a percentage of the profits; this plan succeeded but poorly, though about 200,000 acres have thus been replanted. But when, under the laws for self-government, the communes were compelled to raise and expend funds, it began to be seen that the planting up of the communal waste lands with trees was likely to be very profitable, and thus increase the communal income outside of taxation.* The recent Forest Law provides for grants-in-aid of planting, but it would seem that technical advice was given rather than cash; the result however of communal action is mentioned above. Apparently the system of nurseries† is adopted as in the State forests, and owing partly to climate, skill, and class of tree

---

* Compare that Swedish town Orsa where there is no taxation and everything is *free*, schools, trams, lighting, etc., the income from the well conserved communal forests furnishing the necessary funds, and doing so not by wasteful felling but by rigid maintenance and conservation, so that the forests are increasing in value.

† In 1879—81 the writer carried out a system of nurseries in the Erode division from the old Jungle Conservancy Fund; nurseries of useful trees (tamarinds, etc.), were formed at various centres, especially weekly market sites; the young seedlings were transplanted into pots tall enough to allow the top root free play, and ryots coming to the market were supplied gratis with a few plants which they took away in their carts; many thousands were thus distributed, it being found that a ryot—according to the Tamil maxim to treat seedlings like children—will carefully nurture a young seedling though he may not take the trouble to grow it from seed. The plan was perforce abandoned when the Forest Department took over the Jungle Conservancy Fund. For the encouragement of fruit and other trees, the growth of which is essential if diet is to be improved, cattle dung abolished as fuel, restorative leaf manure given to the fields, the regular forests supplemented, domestic needs supplied, and cash provided which will pay the arable field assessment almost irrespective of season, some such plan should be adopted, planting-baskets instead of pots being used; few operations could so benefit the ryot as liberal and liberally aided State-encouraged tree planting.

raised, the saplings are often not transplanted till they are two or three years old.

122. Statistics are not available to show the ownership of the 14 or 15 million acres of individual private forest, but in fact most belong to farmers, and are largely utilised for supplies of green manure; to some extent at least, they are cultivated and planted at considerable expense; they also pay the land tax assessed, like arable land, on their capital value which however is apparently rated very low so that the land tax is low. The State while handing over to the farmers both the arable and the woodlands which they occupied, demands its assessment on each class of land, and where State forests are judged unsuitable (from small size, etc.), for State management or are useful only for manurial herbage, they are sold and assessed. Wood in Japan is regarded as a class of cultivation, and the farmer regularly grows wood, sometimes, as personal observation shows, in a quasi-rotation, but generally as a necessary supplement to arable cultivation and as an addition to his income; Captain Dyer, quoted in an Appendix to Alcock's "Capital of the Tycoon," expressly mentions the planting of trees as a rotation crop, and Kinch in the "Asiatic Transactions" says that many parcels of land are thus fallowed, that is, temporarily relieved from arable cultivation and placed under wood. The above remarks relate to woodlands proper and not to orchards and fruit trees which, of course, the Japanese farmer treats as a regular and valuable crop, a crop and source of income so sadly neglected in the Madras Presidency where a single tamarind tree occupying and utilizing only a corner of a field or even a backyard, would often pay the full assessment of the ryot's whole holding besides being largely independent of season and a valuable asset of capital.

123. In Japan the statistical reports on the silk, mulberry, tea, etc., expressly take note of the area planted not in regular fields but *as borders to the other fields, in house-gardens, etc., as indeed may* be seen by any observer; these border plantations amounted in 1904 to the astonishing amount of 189,465 and 49,905 acres respectively, or 24 per cent and 40 per cent of the whole area of silk, mulberry and tea. So Dr. Nagai speaks of the valuable paper mulberry as

"chiefly grown" on the borders of the various fields, and the vegetable wax and lacquer trees are also so grown. These are instances of the Japanese passion (a necessary one no doubt) for utilizing waste space and in a most lucrative fashion.*

124. The replanting of private woodlands by Japanese peasants, and its stimulation by Government have been alluded to; the following are some of the provisions of the Forest law relating to conservation of forests, and it will be seen that the Japanese Government is prepared to, and doubtless often does, exercise a controlling power over such forests of whatever description; it will be remembered that all "private" forests are of a minute description, though occasionally forming large blocks by contiguity. Moreover, the provision in sections 3 to 5 makes no mention of public interests or contingent questions but only of the ruin to the forest itself, whereas section 7 and all subsequent sections expressly relate to public interests, *viz.*, to those forests whether private or State known as "Hoanrin," or forests of which the preservation is necessary on public grounds such as to prevent landslips, avalanches, sand-drifts, and to protect sources of water, fisheries, scenery, etc., etc. Private Hoanrin amount to only 1·15 million acres in 185,546 lots, or 6 acres apiece.

"*Section* 3.—When a private forest is likely to be ruined by mismanagement, the Minister (Agriculture) may order a proper system of conservation.

Section 4.—When felling is carried on in disregard of such order, the minister may forbid such felling and may order the owner to plant trees in the area felled.

* There is probably no Revenue Officer who could not suggest similar utilization of waste in his sphere of work; a road bordering paddy fields or irrigation waters, drainage or otherwise, which will bear an avenue of cocoanuts and pay the road upkeep (*experto crede*) several times over; damp corners where splendid trees will grow but which now produce only mosquitos; backyards which would be not merely wholesome but hygienic and productive if planted with trees and flowering shrubs (a Tanjore Brahmin ryot told me of a tamarind tree in his backyard which for generations had produced up to Rs. 40 per annum); borders of fields which will grow fruitful or manurial trees or protective hedges and will thereby be demarcated for ever without fear of cavil or dispute. The tree, using the words in its widest sense, is one of the main hopes of Madras cultivation.

Section 5.—In case the order mentioned in section 4 is not carried out, the authorities may carry out such planting and recover the expense from the owner, or may confiscate the land."

The subsequent sections relate only to the Hoanrin and are of a drastic character, such woodlands being practically treated as "reserved forests," insomuch that even the feeding of cattle, the removal of earth, grass, etc., are forbidden without express sanction. In such cases the owners pay no taxes and may claim compensation for any direct loss caused by the prohibition of felling.

125. These woodlands, then, play an important part in the rural and agricultural economy of Japan, and from the action both of Government, of communal bodies, and of private persons, that part is likely to increase in agricultural and industrial importance The instruction of the people in the general value of woodlands and in the best methods of conserving and developing them, is carefully provided for by the State.

ORIGINAL ARTICLES.

SANDALWOOD AT SEA-LEVEL.

BY M. RAMA RAO, MADRAS FOREST DEPARTMENT.

During a short stay at Pondicherry in the first week of this month (January 1908), I observed a number of sandal trees in the compound of the late Mr. Lakshmanaswamy Chetty's bungalow south of the Railway station. They are chiefly found along the hedge which consists of bamboo clumps, *Thespesia populnea* and other trees and shrubs. There is only one large sandal tree about 2½ ft. in girth, the rest being small poles with a few young seedlings here and there under them. Having found a few saplings cut down by coolies, I had their roots dug up and found root attachments between the sandal and the other species, *viz.*, the big bamboo (*Bambusa arundinacea*), cocoa palm, *Morinda tinctoria*, *Thespesia populnea*, etc. Numerous cases of self-attachment of sandal roots were also found.

On sawing across the thickest stump of one of the saplings, no scented heartwood was found, but there was a thin core of incipient duramen about an inch in diameter. As the basal girth of the sapling was only 10 inches, it was too young to develop scented wood.

The man in charge of the extensive garden attached to the bungalow informed me that the largest sandal tree still standing was originally forked at the base and that one of the stems having been damaged by wind, he cut it off at the base and found good scented heartwood in it. I verified this statement by examining the base of the tree and took out a piece of the old stumpwood which was fairly well scented. Considering that the soil is sandy with an admixture of vegetable detritus only to a depth of about a foot and the tree itself comparatively young being about 30 years old according to the statement of an old gardener still in service, I think the scent is moderately well developed. The piece of wood secured by me is sent to the Honorary Editor for presentation to the Forest College Museum. The man in charge of the garden assured me that the heartwood in the stem which had been previously removed was more strongly developed than in this piece, which is only an outer basal portion. For fear of damaging the standing tree I could not secure a piece of its central heartwood.

In an article headed "Sandalwood at Kurnool," published in the *Indian Forester* of August 1906, unquestionable evidence was adduced to prove that good scented wood was produced by sandal trees at such low altitudes as 900 ft. and 950 ft. even far outside its natural *habitat*. It was stated therein that an immature sandal tree grown at Vizagapatam almost at the sea-level had developed a certain amount of scent. The foregoing facts regarding the sandal wood grown at Pondicherry prove conclusively that the characteristic scent of sandal heartwood is developed even in trees grown at the sea-level. I now feel confident that scented sandalwood of fairly good and marketable quality could be profitably grown even at sea-level in Southern India.

I think these instances are sufficient to disprove the theory that sandal trees do not produce scented heartwood at low

elevations. But if they are held to be still inconclusive, I can only suggest to those who are interested in the matter and who have better opportunities than myself of collecting more confirmatory evidence to test as many of the largest trees as may be found at Madras, Cannanore and Calicut where sandal is said to be growing luxuriantly and to publish their results in the *Indian Forester.* It may be well to bear in mind in testing sandal trees grown on or near the sea coast that in rich and deep soils as well as in deep sandy soils the development of scented heartwood appears to be much slower at first than in the *natural habitat* of sandal.

BANGALORE : 15*th January* 1908. — M. RAMA RAO, *Extra Deputy Conservator of Forests.*

[Mr. F. A. Lodge, Conservator of Forests, in forwarding the above article, remarks that "In South Canara sandal wood was removed from the list of reserved trees on the ground that it produced no heartwood and was therefore valueless. There is nothing on record to show how this conclusion was arrived at." The specimen referred to by M. Rama Rao, we have forwarded to the Museum at the Imperial Forest College, Dehra Dun.— HON. ED.]

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE COMMON STRIPED SQUIRREL.

The common squirrel of India is a fur-covered bundle of iniquity. He is a bigger rascal than either the crow or the sparrow. I am aware that these statements will not be believed by many residents of Northern India. I am sorry, but the truth must be told. Let those who will imagine *Sciurus palmarum* to be a pretty, fluffy, little creature, as charming as he is abundant. I know better. I have sojourned in Madras. In Northern India the little striped squirrel is merely one of the many tribes that live on your frontier, in South India he is the stranger who dwells within your gates. We who are condemned to residence in the plains of Northern India keep our bungalows shut up during the greater part of the year in order to

protect ourselves from the heat, or the cold, or the dust, or whatever climatic ill happens to be in season. And when the weather does permit us to open our doors we have to guard them by means of *chiks* from the hordes of insects that are always ready to rush in upon us. Thus we keep the squirrel at arm's length.

In Madras you lead a very different life. The gentle breeze is always welcome, you rarely if ever close the doors of your bungalow, for extremes of temperature are unknown. Nor are you obliged to protect every aperture by means of a *chik*. There is thus no barrier between the squirrel and yourself. The result is that the impudent little rodent behaves as though he believed that men build their bungalows chiefly for his benefit.

Not content with living rent-free in your house during the nesting season, he expects you to furnish his quarters for him and to provide him with food. As I have hinted elsewhere, Indian bungalows are constructed in such a manner as to lead one to infer that there is a secret compact between the builders and the fowls of the air. The rafters rarely fit properly into the walls, and the spaces left make ideal nesting sites for sparrows and squirrels. These last, although devoid of wings, are such adepts at climbing that there are few spots in any building to which they are unable to gain access.

In Madras punkhas are up all the year round, and, as usually they are pulled only at meal times, squirrels regard them as paths leading to their nests. Running up the hanging rope, walking, Blondin-like, along the leathern thongs that lead to the punkha, jumping from these on to the top of the punkha frame, climbing up the rope to a rafter, and marching along this to the nest are feats which the little striped rodent performs without effort. In default of a suitable cavity the squirrel constructs, among the branches of a tree, a large globular nest, which has the appearance of a conglomeration of grass, straw and rubbish, but it contains a cosily-lined central cavity. Any available soft material is used to make the interior of the nest warm and comfortable. When squirrels are nesting it is not safe to leave any balls or skeins of wool lying about the bungalow.

The fluffy little creatures sometimes display considerable ingenuity in adapting materials for use in nest construction. One rascal of my acquaintance destroyed a nearly new grey *topi*, finding the felt covering and the pith "the very thing" for nest lining.

Books on natural history inform us that the food of this species of squirrel consists of seeds, fruits and buds with an occasional insect by way of condiment. This is the truth, but it is not the whole truth. The above list does not by any means exhaust the menu of *Sciurus palmarum*. My experience shows him to be nearly as omnivorous as the *myna*.

Occasionally I fall asleep again after my *chota hazri* has been brought. In Madras I was sometimes punished for my laziness by the disappearance of the toast or the butter. Needless to state that theft had been perpetrated and that the crows and the squirrels were the culprits.

On one occasion I feigned sleep in order to see what would happen. For a little all was still: presently a squirrel quietly entered the room, took a look round, then climbed up a leg of the table and boldly pulled a piece of toast out of the rack which was within a couple of feet of my face. It was no easy matter for the little thief to climb down the leg of the table with his big load. A loud thud announced that the toast had fallen on to the floor. The squirrel scampered away in alarm, leaving his booty behind him. In a few seconds his head appeared at the doorway; having regarded me attentively with his bright little eye and satisfied himself that all was well, he advanced to the toast and bore it off. But, alas, the way of transgressors is hard! A "lurking, villain crow," who had been watching the theft from the verandah, pounced upon the thief and bore off his ill-gotten toast. The wrath of the squirrel was a sight for the gods. His whole frame quivered as he told that crow what he thought of him.

Sciurus palmarum is very fond of bread-and-milk, and will, in order to obtain this, perform deeds of great daring. I once kept a grackle, or hill *myna*. This bird, when not at large, used to dwell in a wicker cage. In a corner of this cage a saucer of bread-and-milk was sometimes placed. The squirrels soon learned to climb

up the leg of the table on which the cage stood, insert their little paws between the bars, and abstract the bread-and-milk, piece by piece. In order to frustrate them, I placed the saucer in the middle of the cage. Their reply to this was to gnaw through a bar, and boldly enter the cage. They grew so audacious that they used to walk into the cage while I was present in the room; but, of course, the least movement on my part was the signal for them to dash away into the verandah. On one occasion I was too quick for a squirrel who was feeding inside the grackle's cage. I succeeded in placing my hand in front of the gnawed-through bar before he could escape. He dashed about the cage like a thing demented, and so alarmed the *myna*, that I had to let him out. In half an hour he was again inside the cage!

The little striped squirrel feeds largely on the ground. As every Anglo-Indian knows, it squats on its hind legs when eating and nibbles at the food which it holds in its fore paws. In this attitude its appearance is very rat-like, its tail not being much *en evidence*. It is careful never to wander far away from trees in which it immediately takes refuge when alarmed.

It does not always wait for the seeds, etc., upon which it feeds, to fall to the ground, it frequently devours these while still attached to the parent plant. Being very light it can move about on slender boughs. It is able to jump with ease from branch to branch, but in doing so causes a great commotion in the tree: its arboreal movements seem very clumsy when compared with those of birds of the same size.

Squirrels are sociably inclined creatures; when not engaged in rearing up their families they live in colonies in some decayed tree. At sunrise they issue forth from the cavity in which they have slept and bask for a time in the sun before separating to visit their several feeding grounds; at sunset they all return to their dormitory. Before retiring for the night they play hide-and-seek on the old tree, chasing each other in and out of the holes with which it is riddled.

A small colony of squirrels once dwelt in an old *farash* tree in the compound of the office of the Accountant-General of the Punjab.

Unfortunately for the squirrels a pair of green parrots *(Palæornis torquatus)* elected to nest in that tree and evicted the legitimate occupants. The disgusted squirrels had to go, for the parrot's beak is a weapon against which they can do nothing.

Young squirrels are born blind and naked and are then ugly creatures. Their skin shows the three black longitudinal stripes, the marks of Hanuman's fingers—which give this creature its popular name. The hair soon grows and transforms the squirrels.

A baby *Sciurus* makes a charming pet. The rapid movements are a never-failing source of amusement. It is feeding out of your hand, when it takes alarm at apparently nothing, and, before you can realise what has happened, it has disappeared. After a search it is found under the sofa, on the mantel-piece or out in the garden. I know of one who took refuge in its owner's skirts. She had to retire to her room and divest herself of sundry garments before she could recover it.

Once in trying to catch a baby squirrel that was about to leap off the table, I seized the end of its tail; to my astonishment the squirrel went off leaving the terminal inch of its caudal appendage in my hand, nor did the severance of its note of interrogation seem to cause it any pain. A squirrel's tail, like a lamp brush, is composed mainly of bristles.

D. DEWAR.

BIG GAME IN INDIA.

This was the title of a paper read *by Mr. Reginald Gilbert*, F.Z.S., before the Indian section of the Society of Arts, John Street, Adelphi, on 12th December 1907. In the unavoidable absence of Lord Harris, Sir William Lee-Warner occupied the chair. In his opening remarks Mr. Gilbert disclaimed knowledge of wild beasts of India outside the boundaries of Western and Central India and the Central Provinces. After a short account of the disappearance of the lion from Central India, and the turning out last year of young cubs obtained from the Soudan by the Maharaja of Gwalior, the lecturer passed on to the tiger, and gave some account of man-eaters, concerning which he put forward the theory that the practice

was either hereditary or taught to the cubs by man-eating dams. He also gave interesting details as to tiger-netting in Mysore, shooting over water and kills, the habits of the panther, sloth bear, gaur (or Indian bison), and sambur deer. At this point some very fine lantern pictures were thrown on the screen ; all were exceedingly good, but netted tigers, a dead bison, captive elephants in the kheddah, cheetah, and black buck, and two three-year-old bison cows in the gardens at Mysore are worth special mention.

The most important part of the paper was the plea for the preservation of Indian big game, which, Mr. Gilbert said, was now so scarce in the Bombay Presidency as to be dangerously near to the vanishing point. Information received from the Conservator of Forests of the northern circle of Bombay was quoted with regard to the general decline in numbers, and this official laid the blame on poaching villagers and the " wild tribes" rather than on European sportsmen who have to pay licence. A similar view was taken by a Deputy Conservator of Forests in the Central Provinces. The remedies proposed were that the Government rewards for killing tigers and panthers should be abolished except in the case of man-eaters, and that licences should not be issued to natives from March to July, which would put a stop to the indiscriminate slaughter in shooting over water during these months. Mr. Gilbert considered this plan the only way of completing the good work carried on under the forest rules, and in his opinion it would effectually protect big game. Sir W. Lee-Warner expressed his full sympathy with Mr. Gilbert's views and hoped to see the question of preservation of big game put on the same footing in India as it was in Africa. Mr. Gilbert was cordially thanked for his paper.—(*The Field.*)

EXTRACTS FROM OFFICIAL PAPERS.

INDIAN WOODS FOR PACKING-CASES.

SOURCES OF SUPPLY.

We publish below a memorandum on woods for packing cases, compiled for this office by Mr. R. S. Troup, Imperial Forest Economist, at the instance of the Inspector-General of Forests :—

As the manufacture of packing-cases, other than tea-boxes and other boxes for special purposes, has not been extensively carried out in the past, the woods of India have not yet received a very thorough trial for the manufacture of boxes. Below will be found lists of woods used for (1) tea-boxes, (2) Cigar-boxes, and (3) other forms of packing-cases. For detailed information on the woods in question, as regards quantity available and cost of supply, the Conservators of Forests in the Provinces concerned might be addressed.

In addition to the woods mentioned in these lists it is probable that many other woods might be found suitable if they were to receive a trial, particularly in well-wooded Provinces such as Eastern Bengal and Assam, and Burma. In the latter Province a large number of saw-mills are working, and planks could be obtained in quantity ; the cost of supply is another matter, but details could be obtained on application to the Chief Conservator of Forests in Burma, Maymyo.

As regards Assam the supply of *simal* wood is by no means exhausted. In Goalpara and Kamrup there are large supplies of this wood within easy reach of the Gauhati extension of the Eastern Bengal State Railway and also within easy access of the steamers. Details of cost could be obtained on application to the Conservator of Forests, Eastern Bengal and Assam, Shillong.

The following notes apply to the woods used, respectively, for tea-boxes, cigar-boxes and other forms of packing-cases :—

TEA-BOXES.

Although there are many Indian woods well suited for tea-boxes, only certain kinds have been hitherto available at sufficiently

cheap rates delivered in the tea districts. Trials are about to be made with some of the numerous Burmese woods which appear suitable, but it remains to be seen whether these will bear the cost of transport to the Indian tea districts.

The chief woods used or suitable for tea-boxes are the following :—

Scientific name.	Remarks.	Province in which found.
Abies pindrow (silver fir)	A white deal... ...	Punjab, United Provinces (Himalayas).
Acer cœsium ...	......	Ditto. ditto.
Acer Campbellii ...	......	Bengal (Himalayas).
Acer laevigatum ...	......	United Provinces, Bengal (Himalayas).
Acrocarpus fraxinifolius	......	Bengal, Eastern Bengal and Assam (Chittagong), Madras, Lower Burma.
Æsculus indica (Kulu)...	......	Punjab, United Provinces (Himalayas).
Albizzia odoratissima ...	......	All provinces.
Albizzia procera ...	......	Ditto.
Albizzia stipulata ...	Quality variable ; sometimes very good.	Ditto.
Alnus nepalensis ...	Not good ; does not hold nails well.	Punjab, United Provinces (Himalayas), Assam, Hills of Upper Burma.
Alstonia scholaris ...	......	All, but not very abundant.
Amoora Rohituka ...	......	Bengal, Assam, Oudh (Gonda), Bombay, Madras, Burma.
Anacardium occidentale	......	West Coast of India (Bombay and Madras).
Anthocephalus Cadamba	A good box wood ...	Bengal, Eastern Bengal and Assam, West Coast of Bombay and Madras, Burma.
Aquilaria Agallocha ...	Has been recommended ...	Bengal, Eastern Bengal and Assam, Burma (Tenasserim).
Beilschmiedia sikkimensis.	......	Bengal (Himalayas).
Bombax malabaricum (Simal).	Should be either water-seasoned or sawn up green. If seasoned in the log the wood is apt to become discoloured.	All provinces.
Canarium bengalense ...	......	Bengal, Eastern Bengal and Assam.
Canarium sikkimense ...	......	Bengal.
Casearia glomerata ...	Sometimes used ...	Bengal (Himalayas), Eastern Bengal and Assam.
Castanopsis tribuloides	......	United Provinces, Bengal (Himalayas), Eastern Bengal and Assam, Burma, in Hills.
Cedrela microcarpa ...	......	Bengal (Himalayas), Eastern Bengal and Assam.
Cedrela multijuga ...	......	Burma (Tennasserim).
Cedrela Toona ...	A very good tea-box wood...	All provinces.

Scientific name.	Remarks.	Province in which found.
Cinnamomum obtusifolium.	......	Bengal, Eastern Bengal and Assam, Burma, Andamans.
Cordia Myxa ...	......	All provinces.
Dipterocarpus pilusus ...	Said not to be good owing to the resin in the wood, but sometimes used.	Eastern Bengal and Assam.
,, turbinatus	(Gurjan)	Eastern Bengal and Assam, Burma, Andamans.
Duabanga sonneratioides	One of the best tea-box woods, much in request in Bengal and Assam.	Bengal, Eastern Bengal and Assam, Burma.
Echinocarpus dasycarpus	......	Bengal (Himalayas).
Ehretia Wallichiana ...	......	Ditto.
Elœocarpus lanceæfolius.	......	Bengal (Himalayas), Eastern Bengal and Assam.
Engelhardita spicata ...	......	Bengal, Eastern Bengal and Assam, Burma, in Hills.
Erythrina arborescens...	......	Bengal, Eastern Bengal and Assam.
,, indica ...	......	Coasts of Bengal, Burma and Madras.
Ficus glomerata ...	......	All provinces.
Garuga pinnata ...	......	All provinces, including Andamans.
Gmelina arborea ...	Will probably be found too valuable for rough packing-cases. An excellent wood for the better classes of boxes.	All provinces.
Lindera pulcherrima ...	......	United Provinces (Kumaon), Bengal (Himalayas), Eastern Bengal and Assam, Burma, in Hills.
Machilus bombycina ...	Said to be good for tea-boxes, but not much used as the tree is rarely felled, being one of the trees on which the Muga silk worm is reared.	Eastern Bengal and Assam.
,, edulis ...	......	Bengal (Himalayas).
,, Gammieana ...	......	Ditto.
Magnolia Campbellii ...	......	Ditto.
,, Pealiana ...	......	Eastern Bengal and Assam.
,, pterocarpa ...	......	Bengal, Eastern Bengal and Assam.
Mangifera indica (Mango)	The chief tea-box wood in Dehra Dun.	All provinces.
Melia composita ...	Suitable for tea-boxes ...	Bengal (Himalyas), Eastern Bengal and Assam, Bombay, Madras, in Hills.
Michelia Cathcartii ...	......	Bengal (Himalayas), Eastern *Bengal and Assam* (Naga Hills).
,, oblonga ...	......	Eastern Bengal and Assam.
Millingtonia hortensis ...	Probably suitable ...	Much cultivated throughout India.
Morus indica ...	......	Punjab, United Provinces, Bengal.

Scientific name.	Remarks.	Province in which found.
Nyssa sessiliflora ...	......	Bengal (Himalayas).
Pentace burnanica ...	Suitable for tea-boxes ...	Burma.
Phœbe attenuata ...	......	United Provinces, Bengal, Eastern Bengal and Assam.
Picea morinda (Spruce)	A white deal	Punjab, United Provinces, Bengal (Himalayas).
Pinus excelsa (Blue pine)	A pinkish deal, of fine quality	Ditto ditto.
Pinus longifolia (Chir pine, or chil).	A whitish deal ...	Ditto at low elevations.
Podocarpus nerlifolia ...	Very suitable, but probably not obtainable in sufficient quantity.	Bengal, Eastern Bengal and Assam, Burma, Andamans.
Populus ciliata ...	Suitable, but probably not obtainable in large enough quantities.	Punjab, United Provinces, Bengal (Himalayas).
Shorea assamica ...	......	Eastern Bengal and Assam.
Sonneratia apetala ...	......	Tidal forests of Bengal, Madras and Burma.
Spondias axillaris ...	......	Bengal (Himalayas), Nepal.
Sterculia alata ...	......	Bengal, Eastern Bengal and Assam, Burma, Andamans.
,, villosa ...	Formerly not considered suitable, but now much used in Bengal.	All provinces, including Andamans.
Stereospermum chelonoides.	......	All provinces.
Terminalia myriocarpa	......	Bengal, Eastern Bengal and Assam, in Hills.
Tetrameles nudiflora ...	......	Bengal, Eastern Bengal and Assam, Burma, West Coast of Bombay and Madras.
Torricellia tiliœfolia ...	......	Bengal, Eastern Bengal and Assam.
Vateria indica ...	Doubtful	Western Ghauts of Bombay and Madras.
Wendlandia tinctoria ...	......	All provinces.

CIGAR-BOXES.

The chief woods used for cigar-boxes are as follows :—

Scientific name.	Remarks.	Province in which found.
Adina cordifolia ...	......	All provinces.
Cedrela microcarpa ...	......	Bengal (Himalayas), Eastern Bengal and Assam.
,, Toona ...	......	All provinces.
Melia Azedarach (Persian lilac).	......	Cultivated all over India.
,, composita ...	......	Bengal (Himalayas), Eastern Bengal and Assam (Khasia Hills), Bombay and Madras (Western Ghauts).
,, indica (Neem) ...	......	Planted all over India. Wild in Upper Burma, and perhaps in the Deccan and Carnatic.

In addition to these, woods worth trying for cigar-boxes are *Cedrela multijuga* (Burma), *Dysoxylum binectariferum* (Bengal, Assam, Western Ghauts), *Evodia meliæfolia* (Eastern Bengal and Assam), *Pentace burmanica* (Burma), and *Shorea assamica* (Eastern Bengal and Assam).

OTHER FORMS OF PACKING-CASES.

Among the woods more generally used are the following :—

Scientific name.	Remarks.	Province in which found.
Adina cordifolia ...	Has been tried for opium chests, but has not given satisfaction.	All provinces.
Ailanthus excelsa ...	A white soft wood ...	Bombay, Central Provinces, Madras.
Anacardium occidentale	Used for indigo-boxes in Madras.	Introduced from America and established in the coast forests of Bombay and Madras.
Boswellia serrata ...	Used for mica-boxes in Bengal; often used for rough packing-cases, has been unsuccessfully tried for opium-boxes.	All provinces, except Burma and Assam.
Bombax cambodiense ...	Used for packing-cases in Burma. Better than ordinary Simal.	Upper Burma.
Bombax insigne ...	Used for sugar-boxes in Burma. Better than ordinary Simal.	Burma, Bombay (North Kanara), Chittagong.
Butea frondosa ...	Used for rough packing-cases; has to be cut green and seasoned in the plank, otherwise it becomes discoloured.	All provinces.
Cedrus deodara (Deodar)	Used for packing-cases by the Ordnance Department.	Punjab, United Provinces (Himalayas).
Dipterocarpus alatus ...	Used for packing-cases ...	Burma.
,, tuberculatus	Ditto ...	Chittagong.
,, turbinatus...	Ditto ...	Andamans, Eastern Bengal and Assam.
Erythrina indica ...	Used for rough packing-cases	Coasts of Bengal, Burma and Madras.
,, suberosa ...	Ditto ...	All provinces.
Ficus bengalensis ...	Used for opium chests in the Central Provinces.	Ditto.
Hymenodictyon excelsum	Used for packing-cases in Burma.	Ditto.
Lagerstrœmia lanceolata	Coffee-boxes	Bombay and Madras.
Mangifera indica (Mango)	Largely used far packing-cases, for which purpose it is used by the Ordnance Department. Used for opium-boxes, where obtainable, in Bengal.	All provinces.

Scientific name.	Remarks.	Province in which found.
Odina Wodier ...	Packing-cases	All provinces.
Populus alba ...	Afghan grape-boxes ...	Kashmir.
,, nigra ...	Ditto ...	Kashmir, Punjab (Himalayas).
Shorea robusta ...	Formerly used for opium chests, but now considered too expensive.	United Provinces, Central Provinces, Bengal, Eastern Bengal and Assam.
Stephegyne diversifolia	Used for packing-cases in Burma.	Burma, Andamans, Chhittagong.
Sterculia fœtida ...	Used for cheap boxes in Mysore.	Bombay and Madras (West Coast), Burma (Tenasserim).
Terminalia belerica ...	Used for coffee-boxes in Southern India.	All provinces.
Wrightia tomentosa ...	Indigo-boxes	Ditto.

(*Indian Trade Journal*).

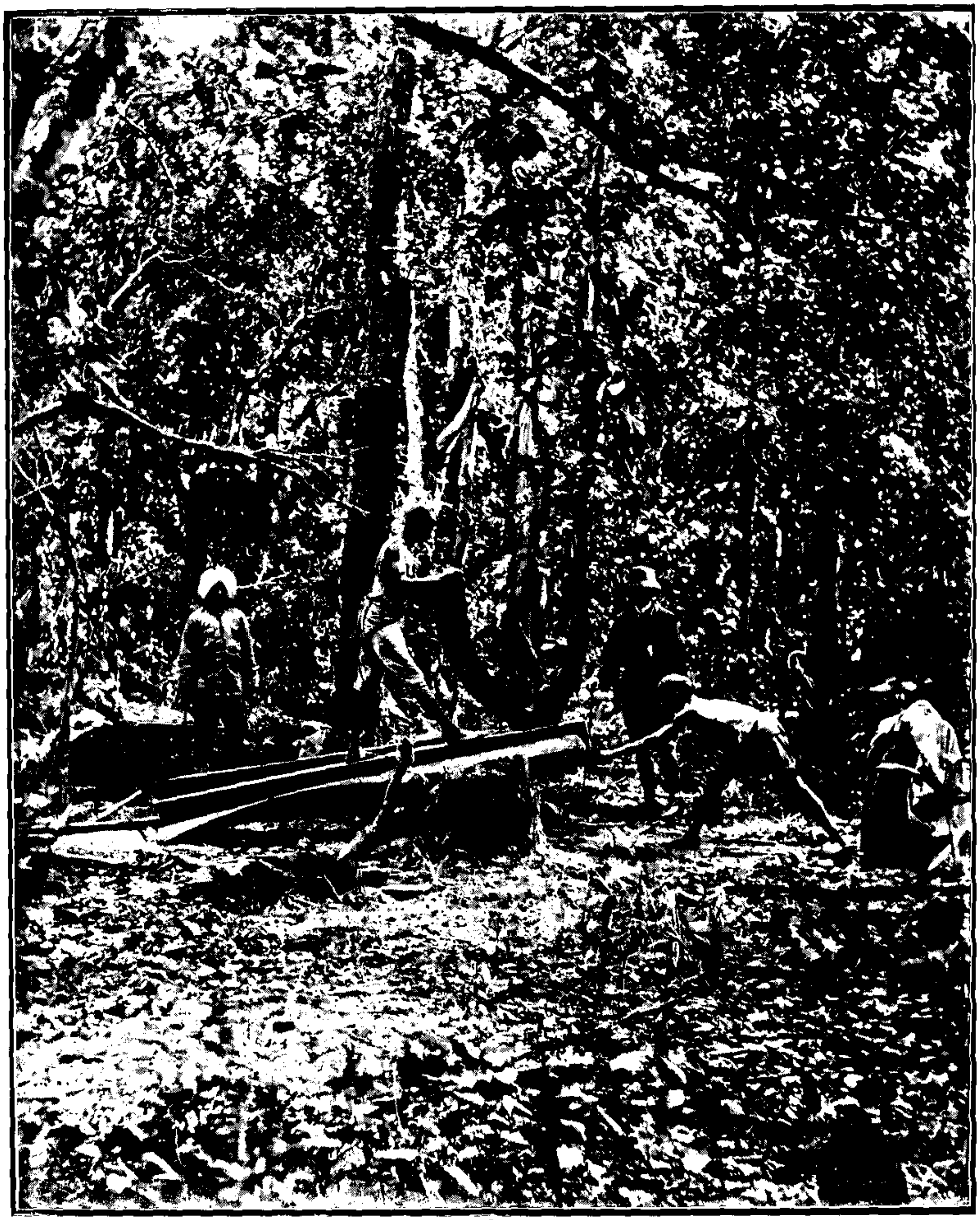


Photo.-Mech. Dept., Thomason College, Roorkee. Photo. by H. Hastings.

Delhi sawyers at work in the Sal Forests, near Dudua, Kheri Division, U.P.

MISCELLANEA.

SAL FORESTS IN KHERI DIVISION, U. P.

Plate 5 shows a 15, road through the Sal Forests near Dudua. These forests are probably the most important in the Province, yielding as they do, more than Rs. 3 net per acre per annum, on the stocked area. The average annual increment in these forests according to calculations made a few years ago by five parties of forest students is 65 cubic feet per acre per annum. It is probable therefore that a century hence the revenue will increase ten-fold.

Plate 6 shows some Delhi sawyers at work in the Forests. These are the best kind of sawyers to be obtained in these parts. A good pair will saw 6 to 7 metre gauge sleepers in a day or about 10 cubit feet. The upper man is the more skilled of the two and guides the saw. He generally earns about Rs. 16 per mensem, while the other man only gets half that sum.

We are indebted for both these photographs to Mr. H. Hastings, Opium Department (retired).

VOLUME XXXIV NUMBER 4

INDIAN FORESTER

APRIL, 1908.

RIGHTS AND PRIVILEGES.

The regulation of rights and privileges is in many parts a very serious question. The usual procedure is to limit them to the present possibility of the forests as regards produce and to limit the number of cattle which may be grazed to about one animal per acre. The question is, whether this procedure is the best arrangement that can be made. We have in mind several forests in which the rights to produce and grazing are allowed up to the above maxima, and it appears to us that if these forests are to be improved at all, a radical change in the regulation of rights is necessary.

Let us first consider the present case of a forest burdened with rights up to its maximum possibility. We can probably, all of us, call to mind such a forest. The area has probably been subject to rights for many years. Within recent times we will suppose that they have been limited to the possibility of the forest, and so at first sight not much harm may be taking place. What, however, is the condition of the present stock of such a forest? Is it a normal crop? We may safely answer that it is not; and that it is probably, say, one-eighth in volume of what a normal crop should be. Now

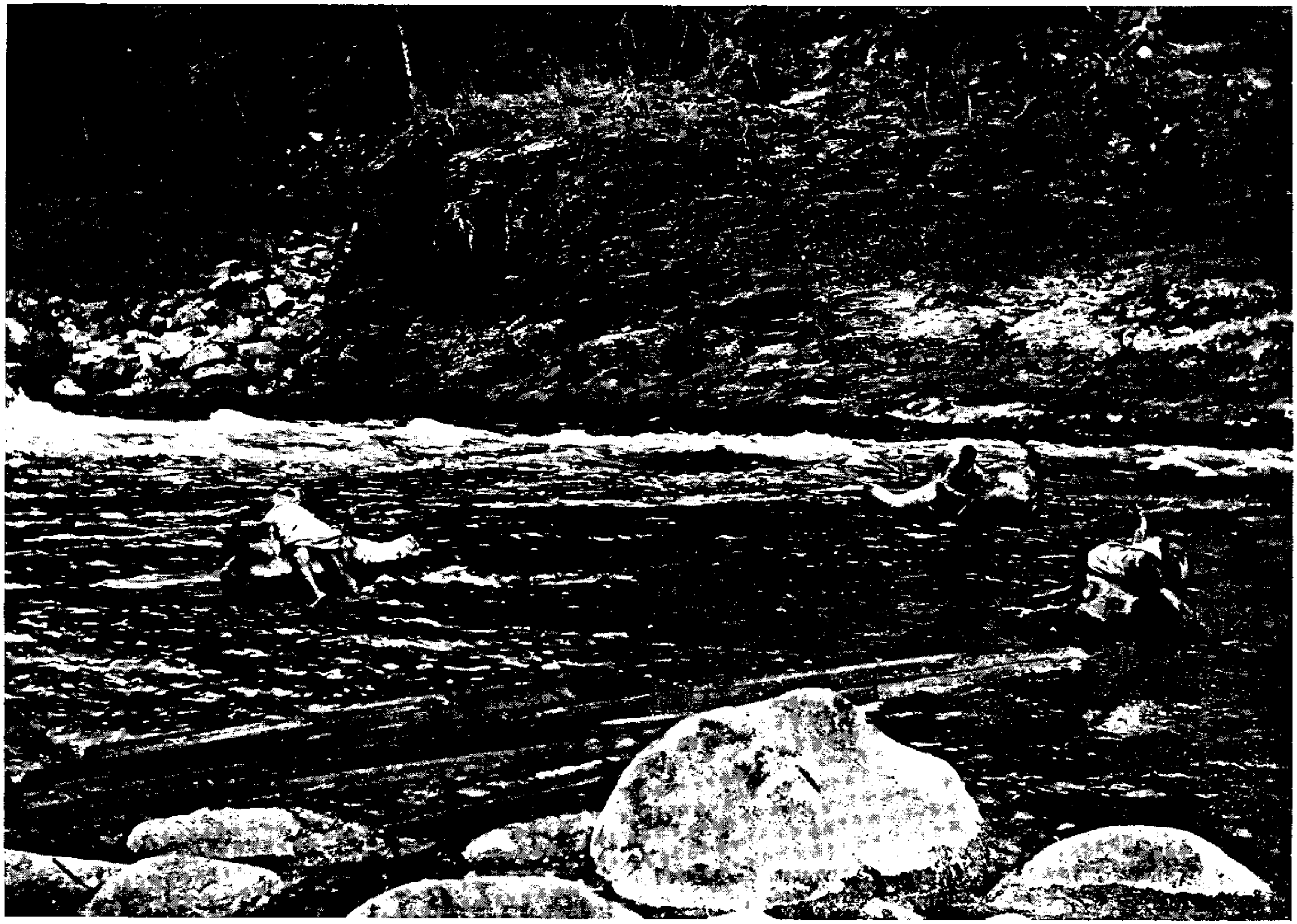


Photo.-Mechl. Dept. Thomason College, Roorkee. Photo. by E. Clutterbuck.

Floating work on the Tons River near Tiuni,
Jaunsar Division, U. P.

in a forest like this, with a stock much below normal, if it were free of rights, it would be managed not up to the present maximum possibility, but considerably below it, in order that each year something would be added to the capital stock and the latter would gradually increase until it reached the volume of a normal crop. Then and then only would it be justifiable to utilize the full annual possibility. It may be urged—that as the stock, in the instance we suppose, is less than normal, the forest must be more or less open and a good deal of the area uncovered—that regeneration will take place on these spaces and that this will tend to increase the stock. This would be the case, if it were not for grazing taking place at the same time. In all the forests which are being managed entirely for the requirements of right-holders and with which we are acquainted, grazing is one of the severest burdens on the forests. The present possibility is utilized to the full (the rights are limited to that) and grazing prevents any increase taking place in the stock. Such a forest is absolutely doomed to remain more or less in its present abnormal condition with a grossly inadequate stock as long as such regulations of rights are in force.

The true aim of the Forester is to get the best possible crop out of the land at his disposal. How the crop is disposed of is of comparatively small importance to him. Whether Government chooses to give away the yield or to sell it for its market value, it is really no concern of his. It is, however, his absolute duty to strive to make the land in his charge produce the best possible crop just as much as an agriculturist strives to obtain a full crop.

Our supposed forest has, we assume, one-eighth in volume of a normal stock, that is to say, its annual yield is a 2-anna one compared to what the normal yield would be (16 annas). The regulations allow for the full yield to be utilized yearly by right-holders, and grazing prevents more regeneration than is possibly sufficient to take the place of the felled trees, and thus the forest is condemned to yield a 2-anna crop as long as such regulations are in force.

Now let us give our attention to the working of the usual regulations to limit the amounts removable by right-holders. In

the first instance, the quantities fixed per village or per household are usually very liberal, much more generally than the actual requirements at the time of the settlement of rights. It is well known that when produce is available free that the grantees are very wasteful and often take out much more than they really require. This is very detrimental to the forest we are taking as an example. Further, the rights are for the sole benefit of the right-holders, but as a rule there is no inquisition as to what the right-holders do with the produce they remove, nor is any such inquisition advisable or feasible. What then generally happens, in a part where the demand for produce is high, is that the right-holders when they don't require the produce themselves, extract it all the same and sell it to outsiders. In some places, the right-holders become regular traders in forest produce obtained by them under rights for their own private use. This is still further detrimental to the forest which has to supply them. Let us suppose that by better regulations we were able to save up these quantities which exceed the actual requirements of right-holders and store them up yearly as additions to the stock, we should be gradually increasing the stock until eventually it would become a normal one. Once normal, with regular management, we should have a normal 16-anna crop instead of our present 2-anna one, and the Forest Officer would have justified his existence by obtaining a full yield from the land in question.

How then is this to be done? The answer is simple—by fix ing the value of rights as a proportionate charge on the profits of the forest and making everyone, right-holders and outsiders, pay full value for all produce they remove. The share of the profits would then be paid to right-holders either in proportion to the land rent paid by them or divided up among households. The advantages of such a system would be enormous—there would be no waste right-holders would only take out what they actually required—it would put a stop to the selling by right-holders of produce they themselves obtained free—it would bring the people much more into sympathy with forest management, for, as it improved, the money yield of their share would increase, and they in fact being

shareholders, would be anxious to help to promote the welfare of the forest in every way. This arrangement would keep down the demand for produce to the actual requirements.

If the right-holders' share of the profits from the forest were to be divided equally among households, the effects would, we consider, be better than if paid in proportion to the land rent paid by them. It would be a somewhat socialistic proceeding, but it need not necessarily be condemned on this account. At present a great proportion of the produce allowed to right-holders is taken by the richer and more well-to-do men, who can afford to pay. If the share of the profits were divided equally among households, these richer men would receive in cash less than what they had spent on forest produce and the poorer men, more, that is to say the poorer classes would be greatly benefited, which is just what is wanted.

As to the legality of this proceeding, we are of opinion that section 15 of the Forest Act which provides for the commutation of rights is sufficient to justify the arrangement proposed.

We strongly urge that in one or two forests, where, on account of the heavy rights, all improvement of the crop is impossible, that this arrangement may be tried experimentally, and if it is proved to be a success, that it should then be gradually applied to all rights of user in the reserved forests. We believe that in this way we shall get the people near the forests thoroughly interested in forest conservancy, and that they will do all they can to help the management to improve the property in which they hold a share.

One further possibility must be mentioned. In some parts forest offences are extremely numerous. The system above advocated lends itself in a marked way to the suppression of such offences. If it was ruled that the share of those who commit offences would be forfeited, for the year in which the offence was committed, we should soon effectively reduce the number of offences.

SCIENTIFIC PAPERS.

EUCALYPTUS TREES.

ECONOMIC USES.

Eucalyptus trees are becoming widely known in India but the virtues of their timber are not generally recognised. The following extract from Circular No. 59 of the United States Forest Service describes the economic uses of the blue gum, the best known species of eucalypt. The circular gives directions as to the propagation, planting and care of the young tree and refutes the common idea that the propagation of the seed is difficult. Reference is made to the fact that eucalypts are peculiarly sensitive to frost, few being able to survive a temperature below 20° F.

The wood of blue gum is very heavy, hard, strong and tough, but it is not durable in contact with the soil. It is close-grained, and is split with difficulty after it has dried. It is less elastic than hickory, but it has been demonstrated by mechanical tests that seasoned blue gum timber is very little inferior in strength and stiffness to the best second growth hickory. In appearance it closely resembles the wood of hickory and ash. Blue gum timber is utilized for a great variety of purposes in California. The wood is excellent for fuel, and in the treeless valleys has been the chief fuel supply for many years. In southern California the steady demand renders commercial planting for fuel very profitable. Eucalyptus timber has been extensively used in California for wharf piling. Blue gum piles are in use in nearly every port on the California coast, and extended trial has shown that they resist the attacks of marine borers which destroy timber in sea water longer than other species commonly used for piling. Blue gum timber has also been used to some extent for fence posts and telephone poles. The wood is not suitable for this purpose, however, on account of its short life in the ground. Seasoned posts last a little longer than green posts, and timber cut from the heart is more durable than sapwood. Blue gum timber has been used

to a limited extent to determine its value for railroad ties. The results thus far obtained indicate that it compares favourably with second-grade pine tie timber. In case blue gum ties gain a place in the market it may be profitable to plant the tree for that purpose. However, if commercial plantations are to be established for ties, sugar gum should be used in preference to blue gum, on account of its greater strength and its greater durability in contact with the soil.

STRENGTH AND TOUGHNESS.

In recent years blue gum has been manufactured into lumber, and has come into favour for many uses. Its strength and toughness have led to its use as a material for vehicle construction with very satisfactory results. A just appreciation of the qualities of gum timber will encourage extensive commercial planting, and so furnish an important source of hardwood timber supply for the Pacific coast. The lumber has been extensively used for vehicle stock and for the wooden parts of agricultural implements. It is also made into insulator pins for electric wiring, and is used for furniture and cabinet work, hardwood flooring, trip-hammer beams, the levers of windlasses, and the blocking for oil and wine presses, wood paving, pulley blocks, and belt wheels.

The extensive utilization of gum lumber has hitherto been prevented chiefly by the scanty supply of timber of merchantable size and by the difficulty experienced in seasoning the lumber without warping and checking. It is believed, however, that in the seasoning of gum no greater difficulties will be encountered than in the seasoning of any other hard wood of similar density and strength.

The esteem in which eucalyptus timber is held in California is based upon the exclusive use of blue gum. In Australia, however, this species is considered inferior in strength and timber value to several other eucalypts. Strength tests of the timber of blue gum and other eucalypts grown in California have sustained this opinion. It is therefore probable that eucalypts are destined to enjoy yet greater favour when these other species become more widely used.

A product of considerable importance derived from blue gum is the oil distilled from the leaves. Eucalyptus oil is recognised as a valuable drug and is extensively used by pharmacists and physicians.

EUCALYPTS WINDBREAKS.

In many valleys of California eucalyptus windbreaks are considered absolutely necessary to insure the successful production of crops. They have been most extensively used to safeguard citrus orchards from strong and destructive winds in southern California, but they are now being established also for the protection of vineyards and orchards of deciduous fruits, olives, and walnuts. The blue gum excels other species for windbreak purposes on account of its height and the rapidity of its growth. The tall shafts of the trees bend before the wind and act as a cushion to deflect it upward over an orchard, whereas ordinary windbreak trees form a more solid wall and the wind draws downward, forming eddies near the leeward side.

Eucalyptus windbreaks planted every quarter mile across level country will give effective protection. Near the foot-hills the belts should be planted closer, since winds blowing down from the mountains gather greater velocity. Through orchards they should generally be planted at intervals of about 200 feet. Where winds are very severe, double or treble rows of trees should be planted. The best spacing of blue gum trees for protective planting is 4 feet apart each way. In double rows the trees of one row should be planted opposite the centre of the spaces in the other. The most effective windbreak protection is secured by a combination of Monterey cypress and blue gum. The trees of each species should be planted in separate rows rather than alternated in a single line. The cypress row will then form a dense understory, closing up the lower openings left by the shed branches of the faster growing eucalypts.

Objection is often made to the blue gum for protective planting on account of its wide rooting habit. It is true that a windbreak draws much moisture from the soil, so that the adjoining rows of orchard trees are often rendered less productive. Wide

extension of the roots may, however, be readily limited without injury to the windbreak. At a distance of from 6 to 10 feet from the windbreak a trench parallel to the trees should be dug to a depth of 3 or 4 feet, cutting off the surface roots of the gum trees. Such trenches should then be refilled, but should be reopened every second year.—*(The Indian Trade Journal.)*

[In the above article no mention is made of the valuable properties of the leaves of blue gum and other eucalypts for boiler cleaning purposes. If a quantity of leaves is placed in water in the boiler and boiled, the decoction will soften any hard incrustation of lime which may have formed, so that it can be readily removed.—HON. ED.]

ORIGINAL ARTICLES.

LIGHT AND SHADE.

A great deal of very interesting literature has appeared of late years on the subject of fire protection. The discussion as to the relative harm which fires do in our forests has chiefly been with respect to teak, though indirectly with regard to other species also.

Now the varying effect of fire on a standing crop is governed by four main factors. Firstly, locality, probably the chief factor; next comes the constitution of the crop; thirdly, the power of the various species to withstand fire, and, lastly, the light and shade-bearing nature of the species. There are also several other factors which are of less importance. Locality and constitution of the crop go very much together, and it is on these two practically constant and more easily determined factors that the whole question turns.

The question of the power to which the various species can withstand fire is a point on which much observation is needed. This article is intended to deal with the last point, *i.e.*, the light and shade-bearing qualities of certain species.

I propose to give a short list of the more common species arranged according to their powers to withstand shade. Without doubt many officers will quarrel with this list, it being no easy matter to class trees and shrubs in such a way.

Plate 10.

Photo.-Mechl. Dept. Thomason College, Roorkee.

Photo. by E. Clutterbuck.

Floating work on the Tons River near Tiuni,
Jaunsar Division, U. P.

Moreover the localities from which the notes have been collected is limited to three districts of the Bombay Presidency, *i.e.*, West Khandesh in the northern Deccan, rainfall from 35 to 40 inches; the Panch Mahals in East Guzarat, with a rainfall of 40 to 45; the West Division of Northern Kanara, with a rainfall of 100 inches and upwards. The notes cover a period of several years chiefly taken during the touring season. Only a very limited number of species are given as on the many other species which occur in these localities my notes are insufficient to qualify them being included or are non-existent.

A further difficulty in making such a classification is that certain species persist under shade in youth, though being light demanders in more advanced age.

I have divided the species into five classes, but have not attempted to make any distinction between the species in any given class.

Class I represents strong light demanders; Class II light demanders; Class III partial light demanders; Class IV shade-bearers; Class V heavy shade-bearers.

Classes I and II might almost be grouped together, while there is little difference between Classes IV and V.

CLASS I.

STRONG LIGHT DEMANDERS.

Adina cordifolia.

1. Saplings and poles repeatedly found killed by shade, in one instance a portion of a young tree under dense shade of *Xylia dolabriformis* was killed, while the other portion of the tree was avoiding the lateral shade. In after life the tree is generally seen standing with its crown above the surrounding growth.

Bassia latifolia.

2. When found in dense jungle, which is not often, or on the edge of *nullas*, it will be seen avoiding the shade. A case was noticed at Kaliakua in the Panch Mahals, where a closely planted group of *Bassia latifolia* were growing together. The centre trees were much drawn up, while a tree, presumably of the same age was

entirely suppressed, only having a few straggling leaves as a crown.

Boswellia serrata.

3. Its mode of growth and the localities in which it is found point to this species being light demanding, it certainly likes light and air and is rarely found in dense deciduous jungles. In the few cases where such trees do occur they present a lanky unnatural appearance.

Bombax malabaricum.

4. This species is certainly light demanding, but to what extent is hard to say; seedlings certainly avoid shade while more mature trees owing to their great rate of growth soon get their heads above the surrounding growth. I personally think it to be a strong light demander.

Gmelina arborea.

5. Saplings seen in dense places were much drawn up, presenting a lanky appearance. Older trees seen overshadowed on one side bending out towards the light, which makes one believe it will stand little shade.

Terminalia tomentosa.

6. Without doubt a strong light demander. Where found in well stocked jungle it has a fine clean straight stem, and if pressed for space is apt to be very lanky. Where favourable soil is found for natural regeneration, it only appears where there is sufficient light. Thus in the Ankola Forests of Kanara or on the black fertile soil in Godhra, Panch Mahals, where the species grows well, only in fairly large gaps, roadsides, old cultivated fields in forests and along lines, do seedlings appear. If the opening is not sufficiently large, though the locality is favourable, other more shade-bearing species occur, though were the gap to be enlarged, I feel sure *Terminalia tomentosa* would predominate. Again saplings overgrown or struggling for light will invariably be found suppressed.

Tectona grandis.

7. Seedlings persist for a considerable time in shade and recover if the shade is removed. That the tree likes light and air there is no doubt. Its habits are too well known to require further remarks.

Casuarina equisetifolia.

8. A strong light demander as may be seen by the number of suppressed trees in the plantations of Karwar and Ankola in Kanara.

9. A strong light demander. Instances of trees are recorded which have been entirely suppressed and killed by shade. Further, trees in dense forest appear lanky and have poor crowns if pressed for space.

Grewia tilliæfolia.

CLASS II.

LIGHT DEMANDERS.

1. In the Panch Mahals this species is not at its best being twisted, crooked and of poor height growth. Where, however, it occurred in dense places it was fairly straight and much drawn up to the light.

Acacia catechu.

In Khandesh it is a better tree and notes show seedlings were found growing in some shade, while older trees, under partial shade were bending away towards the light. It may be said to bear a little shade in youth.

2. As regards its shade-bearing capacity it may be said to resemble *Acacia catechu*, perhaps standing a little more shade than that species.

Acacia leucophlœa.

3. Seedlings stand considerable lateral shade. Poles grown up straight if in dense places, or when growing close together in groups, while old trees in open places are generally crooked, low branching, which leads one to believe it naturally likes light. Fernandez puts it down as a "strong" light demander, I should omit the word, "strong."

Anogeissus latifolia.

4. This species does not as a rule grow into a tall straight tree, though in a few cases where it found itself in well stocked places, it was found much drawn up, forming a straight pole of unnatural appearance. It certainly bears a little shade as it may often be seen growing under somewhat heavy crowned trees, though seeking the light.

Bauhinia racemosa.

5. Generally found with its head clear, though occasionally seen in lateral shade; it is, I think, slightly more light demanding than *Bauhinia racemosa*.

Bauhinia malabarica.

6. Generally found in more open forests, not subjected to shade. I have never noticed seedlings of this species coming up in the shade of other trees.

Cochlospermum gossypium.

7. Generally found in Kanara in evergreen or semi-evergreen jungle, where it stood with its crown far above the surrounding growth. On one occasion, when found growing rather under some larger trees all the *Jambul* were pushing their crowns out from under the shade, it is therefore placed for the present as a light demander.

Eugenia Jambolana.

8. A light demander, seedlings rarely found growing in shade, and older trees always bending to the light if over-shadowed.

Lagerstrœmia parviflora.

9. Not a true forest tree. Where found growing in the jungle, such places often being deserted villages or former cultivation on which tree growth has sprung up, if pressed for space and light it presents an unnatural appearance, being lanky with small crowns, leading one to believe its natural tendency is to avoid shade. Again, it is sometimes found growing to a small tree on the rocky, poor soiled, hillocks of the Deccan, covered with large clumps of cactus and thorny shrubs, much overgrazed, where few trees ever have a chance of growing. Growing up through the abovementioned cactus clumps is often found a slender *Nimb* tree having managed to push up through the slender shade and protection of the cactus and become very lanky and thin due to its light demanding qualities.

Melia indica or Azadirachta.

10. A light demander. When growing in restricted space it is always much drawn up to the light. It is unusual to find seedlings growing even in lateral shade.

Odina Wodier.

11. A light demander, though not to the extent of *Terminalia tomentosa*. Poles and mature trees are sometimes seen growing healthy under some lateral shade. When the two species are growing together, as for instance, below ghats in Kanara, you will find small open spaces filled with *Terminalia paniculata*, *Xylia dolabriformis*, *Lagerstrœmia microcarpa* and other seedlings but not until a larger space, with more light occurs, do you find seedlings of *Terminalia tomentosa*.

Terminalia paniculata.

Terminalia belerica.

12. In youth will stand some shade while in after life it essentially wants light. It is perhaps less shade-bearing in youth than *Terminalia paniculata.*

Stereospermum xylocarpum.

13. Many trees of this species have been noticed as having grown up under other trees and then as they grew older bent clear of the shade and grown crooked with their crowns pushed out from under the crown of the protecting tree. This would lead one to believe it stands shade in youth, but not having found sufficient seedlings and noted their position, it is hard to gauge its habits in this respect.

Spondias mangifera.

14. Its habits much resemble those of *Odina Wodier.*

Dalbergia paniculata.

15. It avoids shade being much drawn up in dense places, rarely even being found growing in lateral shade.

CLASS III.

PARTIAL LIGHT DEMANDERS.

Albizzia Lebbek.

1. This species stands some shade though it likes space to form its crown. Seedlings have repeatedly been recorded growing happily in heavy vertical shade.

Albizzia odoratissima.

2. Similar in its habits to *Albizzia Lebbek* though if anything more shade-bearing in youth.

Bauhinia Lawii or foveolata.

3. More shade-bearing than *Bauhinia racemosa*, or *malabarica.* When standing amongst dense growth it grows very straight but the pole does not give one the idea of being slender or weak. Foliage under shade is also found which is not generally the case with light demanders. Seedlings may be found where no seedlings of *Terminalia tomentosa* or even *paniculata* would be found.

Dalbergia latifolia.

4. Though it stands even vertical shade, especially in youth it likes to have space. In cases when pressed for light the stems are straight,

though not distended, whereas in open situations it is often somewhat crooked and low branching. In somewhat dense groups, as poles, the struggle for existence is apparent, though the saplings left behind do not appear suppressed but healthy. It is rather a matter of opinion as to if it should be put into Class IV.

Hardwickia binata.

5. A difficult species to position, not only as regards its shade-bearing capacity, but as regards all its sylvicultural requirements. It has been placed in Class III on account of its shade-bearing qualities as a seedling and in the pole stage. It is found in the Khandesh and Nasik district as young, more or less even aged, pole woods and also spasmodically in deciduous forests. In the former the more backward poles and saplings standing under the better growth seem to be going on happily and to have by no means a suppressed appearance. Seedlings may be often seen coming up under the shade of the parent tree.

Diospyros melanoxylon.

6. In youth and as a pole a somewhat heavy shade-bearer ; in some cases it has been noticed even growing straight, close against a larger though not heavy crowned tree. In after life it appears to require more light, a not uncommon character of many species.

Holarrhena antidysenterica.

7. It persists in shade but generally looks sickly in such situations.

Pterocarpus Marsupium.

8. Though a light demander in advanced life, the seedlings and even poles stand considerable lateral though not vertical shade. The seedlings have been repeatedly seen growing up vigorously through a somewhat heavy growth of *Nyctanthes arbortristis*, and standing in the somewhat open shade of semi-high deciduous forest.

Schrebera swietenioides.

9. A partial shade-bearer. Though I have rarely found seedlings growing in shade, overshadowed trees in advanced age are not uncommonly seen in forest growing quite happily nor apparently trying to avoid the shade.

10. An average shade-bearer, as may be seen from its shape when overshadowed. In the type of forest in which it is found in the Deccan it is not often subjected to much shade.

Zizyphus jujuba.

Zizyphus xylopyra.

11. If anything rather more shade-bearing than *Zizyphus jujuba.*

Lagerstrœmia microcarpa.

12. When found in Kanara, below ghats, in the old "Kumri" lands in unfavourable places for *Terminalia tomentosa*, *i.e.*, on the slopes and upper hillsides, where it comes into existence together with dense growth of *Xylia dolabriformis*, it has to compete with this heavy crowned species and has often to stand considerable shade, yet it manages to come through, owing to its somewhat shade-bearing character and faster growth.

In true deciduous forest, poles may often be seen pushing their way up through the overhead cover, which is generally not dense but quite sufficient to suppress, say, teak.

Strychnos Nuxvomica.

13. An average shade-bearer though not so much so as *Strychnos potatorum.*

Vitex altissima.

14. It will stand a good deal of lateral shade, though noticed a it has been repeatedly voiding vertical shade.

CLASS IV.

SHADE-BEARERS.

Butea frondosa.

1. A shade-bearer, commonly seen growing in the Deccan and Guzarat under large heavy crowned trees.

Mangifera indica.

2. Though very happy surrounded by light and air, it will stand a great deal of shade, as may be seen in the semi-evergreen and evergreen forest of Kanara, where it has to make headway against heavy shade. Where found in deciduous forest, it has been noticed growing up quite normally through the crowns of the surrounding species.

3. A shade-bearer, very common in the Panch Mahals where groups of seedlings and poles may be seen growing happily up through vertical shade.

Soymida febrifuga.

4. A not uncommon undergrowth in the deciduous forest of the Panch Mahals.

Wrightia tinctoria.

5. A shade-bearer, though not often found in forests in any numbers. It is put as a shade-bearer chiefly owing to its dense low crown, the under foliage of which could not exist were it light demanding.

Mimusops Elengi.

6. A shade-bearer, though as to if it is properly placed and should not be in Class III, I am not certain.

Schleichera trijuga.

7. A shade-bearer, common in East Godhra, of the Panch Mahals, where though only found locally it is very common. It may here be seen growing up under the overshadowing deciduous forest and even close up against and under other trees.

Strychnos potatorum.

8. Commonly found in the forest of Kanara below ghats, and here found growing under heavy shade of such species as *Xylia dolabriformis*, *Dillenia pentagyna*, etc.

Careya arborea.

9. Often found growing in the semi-evergreen patches of forests where it has repeatedly been seen growing under heavy shade and pushing its crown into the over-hanging foliage.

Garcinia indica.

CLASS V.

HEAVY SHADE-BEARERS.

1. Besides being a tree that grows well in open places, it has also been repeatedly noted as growing in dense shade. It has been seen growing straight and to 30 to 35 feet high up against and under the somewhat dense crown of *Soymida febrifuga*. Groups of seedlings were seen in Tunki forests of the Panch Mahals, in heavy lateral shade, though one noted in vertical shade was somewhat lanky

Aegle Marmelos.

though perfectly vigorous. Again poles of 25 feet height are recorded as growing on the edge of a *nulla* in dense vertical shade with normal crowns and quite straight. Similarly in other places it has been noted as a shade-bearer.

2. A heavy shade-bearing shrub, commonly forming undergrowth where even no grass will grow owing to the shade.

Helicteres Isora.

3. A common shrub in the teak forests of the Deccan and Guzarat where it grows in well stocked forests under such shade as is given by mixed teak jungle of that type.

Nyctanthes arbortristis.

4. That it is a shade-bearer may be seen by walking along most rivers and *nullas* in the Deccan and elsewhere.

Pongamia glabra.

5. Found in the deciduous forests of Kanara below ghats, here it is found growing in dense shade, especially when in the seedling and pole stage.

Macaranga Roxburghii.

6. A heavy shade-bearer, most persistent, which when growing in the Kanara district under dense shade, retards natural regeneration. I have not found it so often under bamboo, and it is possible it avoids true teak areas, but on this point I am not sure.

Strobilanthes callosus.

7. One of the heaviest shade-bearers in the deciduous and semi-evergreen forest of Kanara. Found pure or nearly so on the old Kumri lands regenerating profusely, even in heavy shade, and owing to its shade-bearing properties it is probably gradually usurping the soil in certain deciduous forests.

Xylia dolabriformis.

Of the above 54 species, 38 belong to the more light demanding kinds, and only 16 are shade-bearers or partial shade-bearers. It is also noticeable that nearly all our valuable trees given in the above list belong to the light demanders. Of the shade-bearers in Class IV, the Mango and the *Ryan* (*Mimusops Elengi*) are better known for their fruit than for their timber, while *Schleichera trijuga* is not a first class wood, though hard and used for agricultural purposes. Of Class V, three if not four are bushes and form

undergrowth, while *Xylia dolabriformis* though an important species may not always prove a blessing to the forester.

I had expected to find considerable differences in the shade-bearing qualities of the same species when growing under varying conditions, namely, the dry zone of the Deccan and the moist climate of Kanara. In the latter locality the forests are denser, the growth greater, and therefore all species though more vigorous and existing under a greater struggle for existence, the more likely to bear shade. Their shade-bearing capacities, however, appear practically unaltered.

The reason for including many of the inferior species and shrubs in the above list and noting the effect of light and shade on the same, is that they often play an important rôle in the future of our forests.

Without having a fair idea of the value of the more common species as regards their shade-bearing capacity in any given forest, the effect of fire-protection on the future constitution of the crop is difficult to define. Even more important is this knowledge when one has to carry out improvement fellings, for it is impossible to lay down fixed rules for such an operation, the success of which will depend entirely on the knowledge and skill of the local officer.

The above remarks apply principally to the treatment of high forest under the selection system. The list has no pretentions of being anything but a mixed one, very incomplete and liable to alteration; it is only an attempt to show the importance of the subject with regard to fire-protection and improvement fellings. As regards the former, a list showing the power of the various species to withstand fire would be still more important.

CAMP KADRA: R. S. PEARSON, I.F.S., F.L.S.
Kanara, 14*th February* 1908.

METHOD OF CHARCOAL BURNING IN SALEM DIVISION.

On my joining the Harur range in South Salem Division, was called on to make some charcoal. Accordingly, I collected

some coolies, who knew a rude though intelligent form of charcoal burning. They made some charcoal which was not very good. Their kiln was rather loosely built and allowed the smoke to pass through the top. This charcoal fetched a price of Rs. 10 to Rs. 12-8 per ton locally, being somewhat inferior. Then I adopted the following form of kiln which is nothing more than the parabolloid kiln of Dehra Dun, but this one gives better results and is not so complicated in working and making.

Description.

The billets are cut to a length of 4 ft. Even while the fuel is quite green, the kiln can be arranged by using the biggest pieces for the innermost ring leaving a vertical hollow of 2 ft. in diameter in the middle. This hollow is connected with the outer side of the kiln by a channel which is made by temporarily placing a long straight piece of wood, leading from the central hollow to the outside. The kiln may be built on any level ground and no digging or preparation of the site is necessary. Having arranged the biggest pieces around the firing centre, smaller pieces are arranged vertically in concentric outer layers and even the smallest branches and twigs are used in the outermost layer. All through, the interstices between the larger billets are filled up by smaller pieces in order that the stacking may be as tight as possible. The diameter of the kiln is from 8 to 12 ft. according to the quantity of wood used. In covering the kiln, a ring 9 in. thick of brushwood and branches, like a well crib is supported at 1 foot from the ground by props of short forked billets driven into the ground. Making a smooth curve with this outer ring, leaves and brushwood are thrown over. Then moist earth is put on to a thickness of 2 in. and pressed down to make it as airtight as possible. The greater part of the weight of the outer covering of leaves and earth is supported by the short props which hold up the crib like ring. All below this ring is uncovered, allowing free access of air. Generally 4 to 6 tons of wood are used for a kiln, but even up to 10 tons can be used at a time. Smaller kilns, however, are much more easily managed than the bigger ones of 8 or 10 tons. The kiln can be built at any level place irrespective of the distance from water, for

6 or 7 buckets will suffice for preparing the earth for the covering and this small quantity can be brought from a distance if necessary.

Firing.

A torch is passed through the channel-like opening into the central space which is filled with dry brushwood. This channel is left open for 2 hours, after which it is closed up with wood.

Working of the kiln.

As soon as the kiln has taken fire it has to be watched by 2 or 3 coolies until the whole kiln is burnt. Short pieces of fuel are kept ready to fill up hollows which occur when the kiln settles on account of the burning of the inner layers of wood. Whenever such hollows occur they are easily filled with pieces of fuel; the covering is repaired with leaves and earth and made airtight once more. There is no making of holes for air at various heights as in the ordinary parabolloid kiln. The burning continues from 3 to 4 days according to the size of the kiln. Any outside air current does not affect this kiln perceptibly as it does when holes are left for controlling the burning. When the fire has reached the outermost layer and the outer covering of leaves is burnt, the bottom 1 foot opening is closed completely and the kiln is allowed to cool down for a day, after which the charcoal is taken out.

Advantages of the kiln.

(1) Water is not required close at hand.

(2) Outer air currents do not affect the burning.

(3) The outturn in good charcoal is from 25 to 30 per cent of the weight of the wood; the minimum is 25 per cent.

(4) Green fuel may be used in this kiln and no time need be lost in drying the wood. Dry wood is a disadvantage and green fuel is particularly advantageous as it moderates the burning to an immense degree.

(5) Even the smallest branches are used and on opening the kiln it can be seen that even leaves sometimes retain their form after being carbonised showing that as little disturbance as possible takes place and burning is moderated exactly and automatically by the green fuel.

(6) The period of burning is comparatively very short, being only 2 or 3 days.

(7) Control is very easy as the coolies have only to fill up all newly-formed cracks and crevices and nothing else; the chances of anything going wrong are very limited.

(8) The charcoal is very good in quality being heavy and metallic and never crumbling to pieces. When the kiln is opened, the fuel billets all retain their full size even the bark on them being converted into charcoal.

(9) The unburnt pieces are very few being chiefly within 1 foot of the ground and confined only to the bigger pieces. These can be subsequently used in another kiln.

Cost of working.

The fuel is felled, billetted and stacked on the spot. Coolies are paid from 2 to 3 annas per 56 lbs. or Rs. 5 to $7\frac{1}{2}$ per ton according to the density of the forest and the availability of loose earth for covering the kiln. The charcoal sells at an average rate of Rs. 20 per ton, which gives a net profit of Rs. 7 to 8 per ton.

THE IMPROVEMENTS TO BE AIMED AT IN MAKING A CHARCOAL KILN.

We know that coal is nothing but vegetable matter deposited under the earth and subjected to the physical conditions of heat and pressure. The interior of the earth is naturally very hot and the weight of the earth above the buried vegetable matter tends to increase the heat. There is in addition little or no air under the earth especially at great depths. The heat acting on the wet vegetable matter drives all the moisture away in the form of steam, and when the temperature becomes very high chemical changes also set in resulting in the preparation of marsh gas (CH_4) and other hydrocarbons. In this way vegetable matter becomes converted into coal. From this we can understand that the essential condition required for obtaining good charcoal is heat, and, if possible, pressure and not oxygen. Therefore any improvement in the kiln must always tend to the exclusion of unnecessary air

and maintenance of a high temperature sufficient to draw out the last molecule of moisture, in the shape of steam and leave the carbon behind. For instance, a piece of wood placed in a vacuum tube and heated with electricity, will be converted into charcoal without loss of carbon.

Therefore my modification of the kiln consists only in excluding the air as much as possible and maintaining a high temperature only sufficient to carbonise the wood. I do not mean my kiln is perfect, but it seems to be an improvement. Leaving no holes above and only a foot of opening underneath, gives a rush of air below, but the thorough covering outside checks the draft and only allows air upwards in a very limited quantity. By doing so, there is very little conflagration, but the heat is maintained in the following manner.

WHAT TAKES PLACE WHEN THIS KILN BURNS.

(1) Steaming; (2) Heat moderation or checking of conflagration.

STEAMING.

As soon as the kiln is set on fire by lighting the centre, the burning proceeds and the adjoining green pieces of wood first part with their water in the form of steam which is further heated by the flame beneath. This heated steam pervades the whole kiln throughout the operation escaping only in small quantities through the topmost covering. The heated steam parts with its heat to the green wood in the outer ring making up the loss from the flame beneath. Therefore the whole kiln is first subjected to a steaming process, which takes away the main portion of the moisture.

HEAT MODERATION.

(2) The heated steam thus pervading the kiln, in evaporating the moisture from the green wood, loses its latent heat and recoups it from the flame beneath. As this latent heat is an enormous quantity (537 calories) the flame parting with this heat to the steam is not able to burn away rapidly the dried ring of wood which has given off its moisture. However, the burning

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by E. Clutterbuck.

Floating work on the Tons River near Tiuni,
Jaunsar Division, U. P.

continues slowly up and this process continues to the last. Thus there is an automatic adjustment of burning which makes the charcoal superior in quality. By this process there is less loss of heat, the greater part of it being used in charring the wood. This is the result of converting the wood while green, and of keeping the outer cover as much as possible airtight.

T. S. TIRUVENKATACHARI,
Range Officer, Salem, East.

FLOATING WORKS IN THE JAUNSAR DIVISION, U. P.

In the *Indian Forester* for April 1901 we published an article describing the floating works in the Jaunsar Division. With this number four plates are given, showing the men at work in the Tons river as described on page 172 of Volume XXVII for 1901.

CURRENT LITERATURE.

FORESTRY QUARTERLY FOR DECEMBER 1907.—An important article appears by B. E. Fernow on " Taxation of Woodlands." H. D. Everett contributes a long account of " Lumbering in the Philippine Islands." About one-half of the area of these islands is occupied by forests. It is calculated that the annual increment is about 400 million board feet, whereas the annual cut at present is only 40 million board feet. After comparing the weight and strength of timbers from the Philippines with species in use in the U. S., the author goes on to describe the character of the forests, their degree of accessibility, transportation, labour conditions, stumpage prices, market, present lumbering operations, suitable timber tracts available and how to obtain the license for exploiting a tract of timber.

H. P. Baker writes on " The treatment of fence posts to increase their durability." The problem is one of great importance when it is considered that the estimated number of fence posts used annually is 4,000 millions. Anything that can be done to increase the life of these posts will help towards decreasing the annual demand. From all standpoints it is stated the best material so far found for

this purpose is the oil of tar, of which creosote is the commonest form. The methods of application were described on page 509 of the *Indian Forester* for November 1907.

There are many instructive notes on current and periodical literature, and E. J. Zavitz gives an account accompanied by an illustration of an "Effective Screen for Nurseries."

THE SCOTTISH GEOGRAPHICAL MAGAZINE FOR FEBRUARY 1908.—In this number the chief articles are "The Evolution of the Crown Colony of Mauritius" by Sir Charles Bruce, G.C.M.G., and "A Visit to Burma" by A. L. Cross, F.R.C.S., both of which are well worth attention.

THE CYPRUS JOURNAL FOR JANUARY 1908.—This is chiefly interesting from a forest point of view for paper on "Replanting in general and its Effects" being extracts from a report by Mons. F. G. Madon, dated August 1880.

THE TROPICAL AGRICULTURIST AND MAGAZINE OF THE CEYLON AGRICULTURAL SOCIETY FOR JANUARY 1908.—We must specially draw attention to the sections of this Journal on "Plant Sanitation" and "Scientific Agriculture." The account of "Indian Bees" too is well worth perusal. There are altogether 100 pages on all sorts of subjects of interest to agriculturists and planters.

ANIMAL COURAGE.

If one could line up the wild beasts on parade, as Adam is fabled to have done in Eden when he gave them names, in what order should they be arranged from the view-point of courage? Should the first place be assigned to the lion, tiger, bear, or elephant? A difficult problem this to solve. Still the pursuit of its solution will lead us over the most interesting territory in the province of natural history.

For ages past, wild animals have been matched against one another in the struggle for existence. Hence there has arisen an

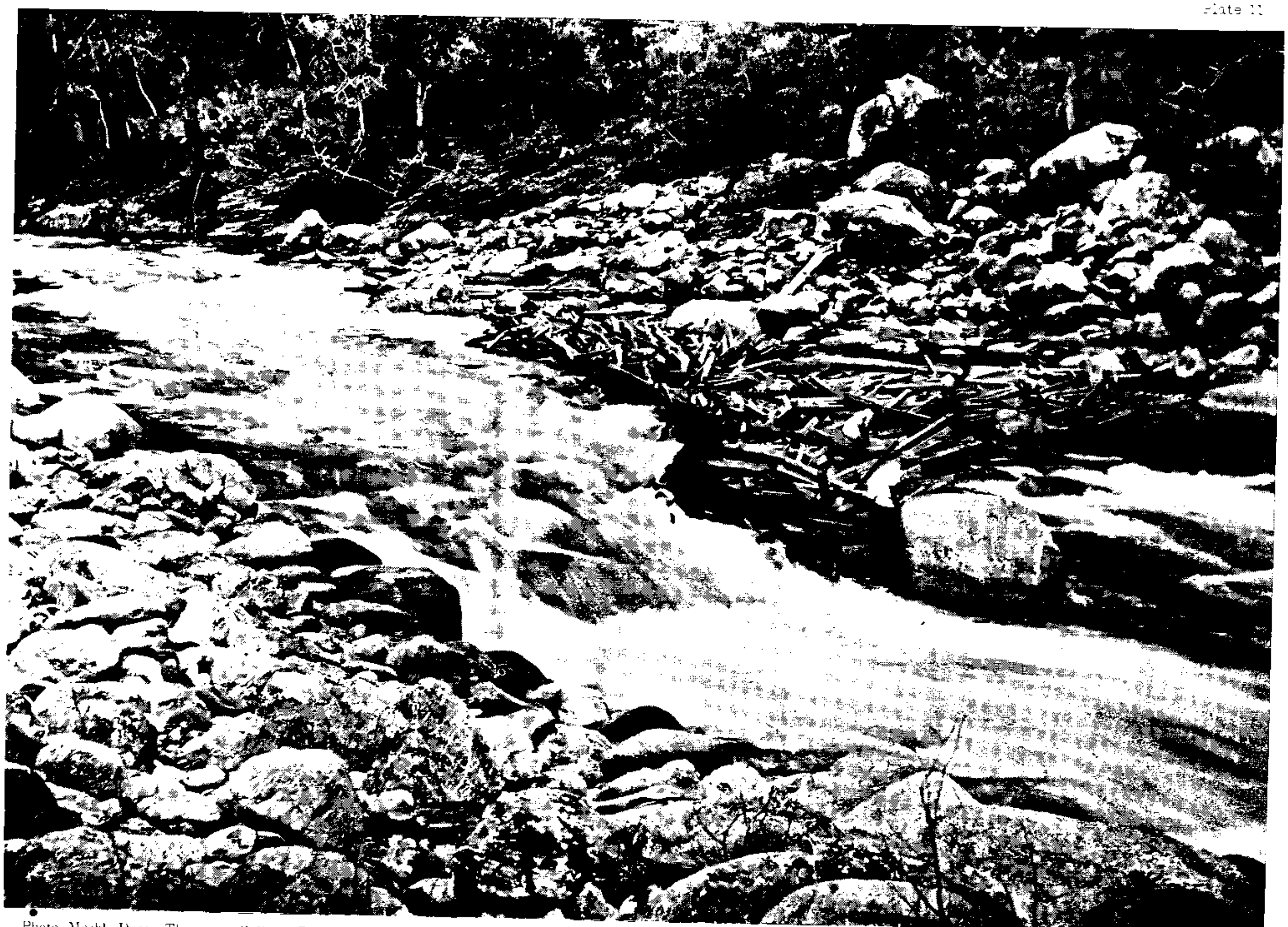


Photo.-Mech. Dept., Thomason College, Roorkee.

Photo. by E. Clutterbuck.

Floating work on the Tons River near Tiuni,
Jaunsar Division, U. P.

established order of things; and the animal world can be roughly divided into beasts that prey and beasts that are preyed upon. In their mutual struggle is displayed defensive as well as aggressive courage. Man has been sometimes a witness of these brute combats in the jungle. In the Roman amphitheatre wild beasts were pitted against one another. But little is to be learned as regards their relative prowess from battles so conditioned, for captivity profoundly alters the nature of wild animals. Moreover man, in the case of the matador, has stepped himself into the ring to test the prowess of one among his reputed inferiors.

It is from the behaviour of savage beasts in face of their natural enemy that we can most easily infer their courage. As regards this there is a vast quantity of floating tradition in all countries where big game exists. There are the relations and personal anecdotes, more or less reliable, of hunters, trappers, and men of the wilderness. More important is the large body of evidence collected in the writings of famous explorers and sportsmen, of such men as Hornaday and Roosevelt, Samuel Baker and Gordon Cumming, to pick only a few noted names.

Let us take the case of the elephant first. Has he, the "biggest born of earth," a heart in proportion to his enormous bulk? Elephants, both African and Indian, have been hunted almost to the point of extermination for the sake of their ivory. Though admirably equipped by nature both for offence and defence, protected by a thick hide and armed with long tusks, they have not been able to hold their own against the cunning of man. Even without firearms the savages of Africa destroy great numbers of them.

The Asiatic elephant has been longest under observation. It has been trained to the service of man from time immemorial—as carriage of state, traction engine, even as a piler of lumber. The monster has proved docile, tractable, and intelligent. As the ally of man on his hunting expeditions, its staunchness has often been put to the test. Now it is a fact well known to all Indian hunters, and attested by such celebrities as Sanderson and Sir Samuel Baker, that the steadiness of the *shikar* elephant is a very uncertain quantity.

Baker relates some annoying experiences he met with while riding on trained elephants of excellent reputation. Some bolted as soon as they smelt or saw a tiger, and tore through the jungle, subjecting him to the risk of being knocked off his seat by the branch of a tree. On one occasion the hunter lost the chance of an easy shot at close range at a tigress because his elephant began to quake like a mountain of jelly, throwing him from one side of the howdah to the other. The weak point of the apparently invulnerable creature is its trunk. This sensitive organ of touch can only be partly coiled out of harm's way, and the wounds inflicted on its exposed surface by a charging tiger are very painful and apt to be remembered long. An elephant that has once been badly clawed about the trunk loses its value for hunting purposes.

That a battle-scarred animal should "funk" is comprehensible, but how shall we account for the peculiar timidity which the elephant exhibits in the presence of dogs? The active movements of its nimble aggressor seem to disconcert the mammoth, and to inspire it with the same feelings that oppress a woman when a mouse scurries towards the haven of her skirts. Elephants dislike to have little dogs get between their legs, where they cannot see them and do not know what tricks they may play. A yapping fox-terrier will drive the huge creature to retreat in a most undignified manner.

More remarkable still is the case, recorded in the annals of Indian sport, of the elephant which ran away from a hare. It was a sensitive female, whose nerves had been shaken by the din made by the beaters and by the roaring of some bears which, however, did not show themselves outside the jungle. But when the little harmless creature darted out of the cover and fled towards the elephant, as to a tower of safety—the tower turned tail. Perhaps the great animal is too intelligent to be perfectly courageous; and its training to service may develop its imagination at the expense of its spirit. It may think too much; and, as Hamlet says, "Conscience doth make cowards of us all."

But when the elephant's sage self-control is destroyed by sexual insanity—when it becomes what is called *musth*—it is

absolutely fearless. The mad creature runs *amok* like a Malay. It begins its career of destruction by killing its keeper, and then proceeds to trample the life out of every human being that crosses its path. The "rogue"—a mildish name for such a terror,—after devouring the stores of grain in the village it has stormed, demolishes the houses out of sheer devilment. But this tempestuous fury is not courage. It only shows what a terrible enemy to mankind in the tropics the elephant would be, were it naturally aggressive.

Fortunately they are not. In the jungle, elephants are only dangerous in the breeding season. As a rule the herds retreat when they wind a hunter. A wounded tusker of course waxes furious and turns on his pursuer, but his charge can usually be stopped or diverted by a shot.

Elephants and tigers, though they live in the same jungles, do not come naturally into competition. The former feed on grass and leaves, the latter on flesh. But "stripes" when prowling walks wide of the herd that he hears tearing the branches down; not that he fears an assault but because he must seek his prey in less disturbed places. Sensible animals learn to mind their own business in the jungle. It is man, working for his own ends, that has brought the two animals into the field against one another.

But at what odds! On the one side an army, a battle line of forty or fifty huge brutes, weighing tons, with the communicated courage that comes from numbers in touch, and the support and encouragement of their lord and master. On the other, a solitary but undaunted animal, small in comparison with even one of its opponents, but, oh! how stout of heart. Who that has seen a royal tiger flash past the muzzles of an array of elephants, challenging them with a ringing roar, waving defiance with his tail, can deny him the meed of superior bravery? Of the opposing horde few dare face him in single combat, and if such a champion be found, the tiger often brings the mammoth to his knees. No wonder that the Indians honour the tiger with the title of prince and rajah of the forest.

But how does the great cat show when its mettle is tried by the lord of creation? The title seems to beg the very question, but

is itself open to dispute. For take away his firearms, or other means of killing at a safe distance, and what will man's naked strength avail against a brute that weighs four hundred pounds and is armed with teeth and claws? Very little. Therefore the royal beast denies a sovereignty that asserts itself so weakly, and either ignores or hunts the arrogant biped. Even where tigers have learned to respect the mystery of the armed man, the rifle damps but does not daunt their courage. It is tempered with a discretion that teaches them not to seek a combat.

A tiger rarely attacks a white man, even when unarmed. A friend of the writer's taking an evening stroll away from his hunting camp, met a tiger face to face on the edge of the jungle. The two killers eyed one another for an instant, the man remaining quite still; then each went his own way. It was like the chance encounter of a pair of rival pugilists on the eve of a match. Yet that great authority, Baker, says it is not safe, if you fall in with a tiger, to trust to the imagined cowing influence of the human eye. You may arouse the suspicions of the animal. Thinking you mean mischief, he may take the initiative and charge. Again, a tigress with cubs will attack anyone that stumbles upon her lair.

A case of this kind happened some years ago in Central India. A young man, hearing that a tiger was lodged in a certain ravine, took a gun with him and ventured alone on the dangerous risk of a stillhunt. Winding him, the animal was the first to attack, rushing suddenly from cover and clawing him severely before he could handle his weapon. This was not the assault of a man-eater, but of a tiger annoyed at being disturbed. It was a warning to "keep out," but so severely punctuated that the intruder died from the shock.

When wounded, the natural courage of the tiger is goaded to a pitch of fury. It is then that the fatal accidents inseparable from this dangerous sport occur. They were often caused by the hollow "express" bullet, which exploded in the muscles and irritated without paralysing the animal. The injured tiger determines to go down to hades, like a hero of old, in the midst of a heap of slain foemen. He springs at those unlucky beaters who have not climbed

out of harm's way, and smites them perhaps to death. Men are mauled or killed outright, stately elephants dragged to the ground, the hunter perhaps wounded, before the courageous tiger receives the finishing stroke.

The lion has long been the accepted type of courage. Heroes, kings, and warriors of olden time adopted the lion as their emblem; and only the bravest of the brave were hailed with the title "lion-hearted." The noble animal has held the centre of the stage so long because he was the most formidable wild beast known to the writers of antiquity, who were themselves not very accurately informed about his character. In Asiatic literature the tiger was equally celebrated, but little was known concerning him to Europeans until comparatively recent times. Before then painter, poet, and sculptor had securely established the lion on the throne as king of the beasts.

Whatever rivalry fabulists may feign to exist between lion and tiger, in nature there is none. One lords it in Asia, the other in Africa. Animal suzerainty indeed belongs rather in the realm of fancy than in that of fact. And whether the king of the beasts can even be said to hold undisputed sway in Africa cannot be determined without taking into account the records of some other denizens of that hunter's paradise.

The human natives indeed, whether forest dwellers or inhabitants of the sandy wastes, are not afraid to match themselves with lions. The Hamram Arabs of Abyssinia hunt the noble quarry on horseback, sword in hand. A common practice with many "bush" tribes is to entangle lions in a labyrinth of nets and then rush in and spear them. Hence *Leo Africanus* has had pounded into him a certain respect for *Homo sapiens*, and as a rule discreetly refrains from attacking his camps north of the equator.

Regarding his boldness in South Africa opinions differ. Livingstone, the celebrated missionary, thought that there was no danger of an attack from the lions in the Zambesi district by day. On dark nights they would venture to attack his oxen, they were less brave when there was moonlight. But the Boers on their "treks," and the Mashonaland explorers, used to surround their camps with

a strong *zareba* of thorny wood, and to keep fires burning all night as a safeguard. In spite of these precautions it sometimes happened that a lion leaped the fence and carried off a sleeping man. Cumming, the lion-hunter, met with such an experience. The robber moreover had the nerve to devour his victim somewhere out in the dark beyond the camp, for the crunching of bones was distinctly heard.

The readiness to attack seems to argue for the superiority of the lion over the tiger, as regards courage. For the latter, although a man-killer in a furtive occasional way, keeps respectfully away from a camp. But there is a considerable difference between the surroundings of the two animals. India is a civilised country with tracts of jungle at intervals; and firearms have been in use there for many years. Africa is still for the greater part a jungle or a desert, with fringes and oases of civilisation; and guns are of comparatively recent introduction there. All this tells on the habits of the animals. The tiger has been longer at the school of caution. But when a tug-of-war between man and brute is unavoidable, as in the case of following up a wounded animal, the tiger is as dangerous every way, and just as likely to turn on and rend his hunters as the lion.

If the attitude of a wild beast towards man and his works is a fair test of courage, the little leopard should rank high among the fighting cats. It would take two big leopards, and a cub thrown in the scale, to balance the weight of an average tiger. Yet the smaller animal shows plenty of "spunk" in a fight, and in addition a quality of nerve perhaps superior to that of his big cousin. "Spots" will take risks at which "stripes" looks askance. A tiger is very suspicious of a trap, but there is no keeping a leopard out of the grounds or even the veranda of a house where dogs are kept. The brutes' mouths water for a tit-bit like a fat little pug or terrier, and their tracks are not rarely discovered around bungalows in jungly localities.

I have seen a leopard expose itself in the daytime quite near to habitations. The attraction in this case was a big retriever, trotting cheerfully along a wooded hill-path just beyond Naini Tal.

The leopard peered over a rock not many feet above the trail and seemed about to spring down; but the approach of a party of pedestrians, whom the dog was preceding, caused him to retreat behind the boulders with a flirt of his tail. In Africa it is not uncommon for leopards to prowl by night into the porches of the huts of solitary settlers and claw at the shutters.

Doubtless the smaller size of the leopard and its resourcefulness in hiding fortify its heart. "Spots" is not easy to hit in the dark, and has a hundred dodges for escaping, if discovered, which the tiger has not, being arboreal in its native haunts. It will prowl over roofs and outhouses where cattle lie, as unconcernedly as a tom-cat. The leopard is a venturesome animal that seems fully persuaded that it has nine lives to risk.

The courage of the great cats as a class is such as one would infer from their habits. They are hunters and killers, armed and active; they feed on flesh and lap blood. In the bears we have a a tribe that is only predatory on occasion. They seem to lead a double life. Now they are meat-eaters for the nonce, like those vegetarians who find it hard to wean themselves entirely from the flesh-pots; and fatten themselves against the winter on the carcasses of deer. Again, they satisfy themselves with an innocent diet of honey, nuts, berries, and insects. With all this they are not of a mild disposition. The bear is the type of a surly man. Samuel Johnson was so ungracious, so overbearing when crossed in dispute, that he was nicknamed "Ursa Major." Bruin is solitary in his habits, morose in temper, and his growl is a warning that he is best left alone.

Bears are of patriotic interest to Americans, not indeed on account of their temper, but because the finest specimen of their tribe is peculiar to this continent—the grizzly. The annals of the West abound with testimony to the courage of old Ephraim—by the way, who gave him that name, and why? They are full of stories of terrific fights between trappers and big bears. But, as Roosevelt has pointed out, the pioneers, though good marksmen, were indifferently armed for battle with a large animal protected by a shaggy coat. The small bullet used was only occasionally

fatal. Hence the "moving accidents," the hand-to-hand encounters, where claws were matched with knives. From these tales the grizzly bear looms forth an ogre of the mountains, a legendary and terrible creature.

The grizzly of the present day, though still formidable enough, is not surrounded with such a halo of terror. Improved firearms have taught the bear discretion. The hailstorm of lead pumped forth from a modern magazine rifle gives pause to the most ferocious temper. Grizzlies, says Roosevelt, do not now attack unprovoked, but if cornered they come on with reckless fury. A bear in a tight place, boxed up in a mountain cleft for example, is nearly certain to turn on his pursuers. Wounded, he will fight to the death against odds. Witness the fate of the soldiers who, riding back to camp, lightly chased and wounded a grizzly. The brute clawed one assailant off his horse, and, when the other dismounted to aid his comrade, threw him down and bit him to death. An intrepid gallantry was shown by that bear of whom it is related that, after being worsted in a fight with a stallion, with broken jaw and smashed face he sallied out from cover to meet the cowboys who had followed up his tracks. There is no questioning the courage of old Ephraim.

The black bear of India sustains the family character for pugnacity. The hot climate perhaps adds a dash of pepper to his temper, for he does not always wait for an affront. This variety is small compared with the grizzly, weighing on the average only 300 pounds, but he is quite as plucky. One would hardly imagine that a bear would face the huge moving bulk of an elephant. Yet they have been observed to leave the cover of the jungle and actually stand, fronting the colossus in a defiant "Come-on!" attitude, and the giant has taken fright and backed away from the roaring David of the woods. It is dangerous work following one of these bears when hit, for a shot does not always scare them from charging too close with the hunter. The ferocity of the grizzly is said to depend upon the amount of resistance it is accustomed to meet with. In the case of the Indian bear, it may be that familiarity with the generally harmless native has bred contempt for men,

and that they are slow to apprehend the white man's power of offence. Though not usually aggressive, there is a determined quality of courage in this bear that makes it formidable.—(*Western Field.*)

THE CALCUTTA ZOOLOGICAL GARDENS.

Extract from the Annual Report for 1906-07 *by Mr. Rambramha Sanyal, Superintendent.*

The following comparative tables show how the various collections of animals in the garden stood during the last four years :—

	Mammals.	Birds.	Reptiles.
1903-04	464	842	238
1904-05	450	855	266
1905-06	432	772	281
1906-07	403	741	307

ACQUISITIONS.

The collection of Birds of Paradise was enriched by the acquisition, by purchase, of two Twelve-wired Birds of Paradise, which were new to the collection.

Among other acquisitions the following deserve notice :—

1 Tiger (presented by Mahant Dalmir Puri of Budhowli in Gaya District).
2 Reticulated Pythons (obtained by purchase).
1 Musk Deer (presented by His Excellency the Prime Minister of Nepal).
1 Black Leopard (purchased).
1 Andaman Robber Crab (presented by Mr. A. J. Parkar).
1 Proboscis Monkey (purchased).
1 Greater Bird of Paradise (purchased).
1 Lesser Bird of Paradise (purchased).
1 Orang Outang (purchased).
1 Brow Antlered Deer (purchased).

A consignment of African, American and English mammals and birds was obtained through the good offices of Mr. R. I. Pocock,

the well-known Superintendent of the Zoological Society's Gardens, London.

The following animals were bred in the menagerie :—

3	Rhesus Monkeys.	1	Rufous necked Wallaby.
5	Coypu rats.	5	Spotted bill Ducks.
4	Spotted Deer.	1	Large billed Parrakeet.
3	Sambur Deer.	4	Common Mynas.
1	Hog Deer.	1	Crested Pigeon.
2	Indian Antelopes.	3	Red Munias.
1	Banting.	2	Undulated grass Parrakeets.

A large number of birds of different species breed in the Garden every year in a wild state and the following is a list of those which bred during the year 1906-07 :—

(1) Indian House Crow—*Corvus splendens* (Viell).
The nesting of the species is often discouraged, and comparatively few of them nest in the garden now.

(2) Indian Tree-Pie—*Dendrocitta rufa* (Scop).
Nest found on a sweet Babul tree (*Inga dulce*).

(3) Jungle Babbler—*Crateropus conorus* (Linn).

(4) Bengal Red-wiskered Bulbul—*Otocompsa emeria* (Linn).

(5) Black Drongo—*Dicrurus ater* (Herm).
No nest has ever been found in the Garden, but the birds have often been observed to carry grass and other materials during the breeding season.

(6) Indian Tailor-Bird—*Orthotomus sutorius* (Forst).

(7) Indian Black-headed Oriole—*Oriolus melanocephalus* (Linn).

(8) Pied Starling—*Sturnopastor contra* (Linn).

(9) Magpie Robin—*Copsychus saularis* (Linn).
Generally selects a mango tree for nesting.

(10) House Sparrow—*Passer domesticus* (Linn).

(11) Red-Backed Woodpecker—*Brachypternus aurantius* (Strickl).

(12) Crimson-breasted Barbet—*Xanthotæma hematocephala* (Shelley).

(13) Common Kingfisher—*Alcedo bengalensis* (Gm).

(14) White-breasted Kingfisher—*Halcyon smyrnensis* (Linn).
(15) Indian Koel—*Eudynamis honoratta* (Walden).
(16) Barn Owl—*Strix flammia* (Linn).
(17) Spotted Owlet—*Athene brama* (Blyth).
(18) Common Pariah Kite—*Milvus govinda* (Sykes).
(19) Spotted Doves—*Turtur suratensis* (Blyth).
(20) White-breasted Water-hen—*Amaurornis phœnicurus* (Salvd).
(21) Little Cormorant—*Phalacrocorax javanicus* (Horsf).
(22) Indian Snake Bird—*Plotus melanogaster* (Gm).
(23) Night Heron—*Nycticorax griseus* (Blyth).

LOSSES.

It is greatly to be deplored that the Indian Lion presented by His Excellency the Viceroy (Lord Curzon) in April 1902 had to be destroyed. Although quite a young animal it was found on its arrival to have been suffering from liver and bowel complaints, and was very unsteady in its movements. Indeed its symptoms generally were strongly suggestive of disease of the spinal cord. Everything that could possibly be done to improve its health and mitigate its sufferings was tried, but the animal never showed any sign of improvement. On the contrary, as it grew in size its unsteady ataxic gait evidently became more and more painful to the animal, rendering it necessary to put an end to its miseries. A list of other losses is given under the Pathological Department.

PATHOLOGICAL DEPARTMENT.

During the latter part of the year the work in this department was carried on under less difficulties, though still on restricted lines than in previous years, owing to the appointment of a competent Assistant Superintendent and the ready and generous help rendered in such matter by the Principal of the Veterinary College at Belgachia.

PROVISIONS.

The Commissariat of the Garden received careful attention. Since the revision of rates in favour of the butcher there has been

less difficulty in procuring beef of a better quality. But there is still room for improvement. The root of the evil, however, lies elsewhere, and will remain untouched so long as the condition of things which now obtains in the local market in respect to its meat supply is not improved. As the question is of much wider importance than the well-being of a few animals in the Zoological Garden, it is hoped that the authorities of the market will move in the matter, and appoint, as a first step towards the improvement in the direction indicated above, a Veterinary Inspector to examine the cattle before they are slaughtered in the Suburban Slaughter-house.

The difficulty of procuring fresh and wholesome milk remained the same as before, and large quantities of preserved milk was therefore used.

The prevailing high prices of food grains were chiefly responsible for the enhanced cost of feeding during the year.

GENERAL CONDITION OF THE ANIMALS.

In spite of the losses recorded, the general condition of the animals, specially of the older inhabitants of the Garden, continued good. In the new open-air aviaries in connection with the "Sornamoyi House," the birds exhibited great activity in nesting, but owing to the unavoidable presence of a few hornbills the result was not as successful as could be desired.

The isolation sheds built some three years ago afforded considerable facilities in keeping the new arrivals, which in many cases carry all sorts of infection, separate from the rest of the collection for some time after their acquisition, and also rendered it possible to isolate the suspected cases for treatment and observation.

COLLECTION OF ANIMALS.

Since the submission of the last report serious attempts have been made to exploit Darjeeling and its neighbourhood for Himalayan animals, specially birds. With the permission of the authorities of the Botanic Garden there, a small cage has been built for the reception of specimens as they come. Mr. F. E. Moller, Vice-Chairman, Darjeeling Municipality, who has kindly agreed to

help the Garden in this connection, has engaged shikaris and care-takers to collect specimens and have them looked after. It is to be hoped that the experiment will prove successful. The experiment if properly conducted may yield satisfactory results in the future, enabling the Calcutta Garden to supply Himalayan specimens to other Gardens of the world.

Arrangements were also made, with the help of the Commissioner of Orissa, the Magistrate of Puri and the Raja Bahadur of Parikud to exploit the Chilka Lake for aquatic birds, and in spite of the lateness of the season when the operation was begun, the result was, on the whole, not unsatisfactory.

VOLUME XXXIV NUMBER 5

INDIAN FORESTER

MAY, 1908.

GRAZING.

One of the most important problems awaiting solution in India is the question of grazing. Although especially important from the point of view of the welfare and development of our valuable State forests, it is equally important with reference to agricultural progress. From time immemorial cattle have grazed throughout the length and breadth of the land, and the effects of centuries upon centuries of grazing, combined with the effects of fire (which itself is chiefly due to the demand for grazing) are to be seen in almost all forests and waste lands to-day. The only parts which have not suffered in this way are the more inaccessible and remote portions of the forests and the fields themselves. Since the formation of reserved forests and the consequent founding of the Forest Department to manage them, some steps have been taken to close portions of the State forests to grazing, but owing to the long standing nature of the custom little progress has been made in the half century which has nearly elapsed since the Forest Department was started. In 1905-06 the total area under

Photo.-Mech. Dept., Thomason College. Roorkee. Photo. by B. Sen Gupta.

External appearance of a young Forest of Macaranga denticulata, 8 to 10 years old.
Jalpaiguri Division, Eastern Bengal.

the management of the department was 233,651 square miles. Of this 16 per cent was closed to all animals and 7 per cent to browsers only, leaving 77 per cent of the forests open to all animals.

Before we go further, it will be advantageous to examine the effects of grazing. We will commence by stating that the subject must be looked at from the point of view of the welfare of the people of the country, and since the greater proportion of them are agriculturists, it must be chiefly looked at from an agricultural point of view.

In the issues of the *Indian Forester* for November 1907, January and March 1908 we endeavoured to indicate the beneficial effects of forests on agriculture, water-supply and irrigation, with special reference to the afforestation of waste lands. If the creation of fresh forest reserves is advisable in the interests of agriculture, it is *a fortiori* necessary for us to manage the existing reserves as intensely as possible. Anything therefore that prevents our utilising the lands under the Forest Department to the utmost, tends to affect the community at large adversely and the agricultural portion of it in particular. Grazing in the first place does incalculable harm to regeneration, and it may be stated generally, that where grazing takes place to any large degree, it is not possible to obtain satisfactory young growth. The complaints on this point are very general, as can be seen from the Forest Administration Reports for the various provinces. The cattle trample down young seedlings, if they appear, while browsers eat them, and all other shoots within reach. Where grazing is permitted the soil from trampling becomes often unfitted for a seed bed. Lastly, grazing is the cause of most forest fires, as these are chiefly started with the object of obtaining green grass when the standing grass is overmature and more or less useless for grazing purposes. In the April number we suggested that in order to have a free hand to improve our forests it would be advantageous to give right holders a share of the profits in cash and to charge full rates for produce and grazing to all. With this arrangement it is probable that fewer cattle would graze, when grazing fees had to be paid, but with regard to

grazing something more would be necessary. Wherever it is possible to grow good forests it is extremely desirable that the people should be gradually educated to export cut fodder from the forests for their cattle instead of the present wasteful system of grazing. *With this end in view, the tendency should be to increase grazing* fees, and, on the other hand, to give every facility for the extraction of cut fodder. We believe it is an established fact that a given area can support a greater number of cattle if they are fed on cut fodder than if they are permitted to graze. It may also be stated that *grass at a certain season, i.e., just when it is about to flower,* contains more nutriment than at any other time. To obtain the maximum amount of food material from a given crop of grass it should all be cut and made into hay at this time. By grazing, a good deal of the grass gets eaten before it has developed, and a little only at the time it is in best condition, while the greater part is allowed to flower and seed, and thus practically becomes useless as food material. Then the desire to burn springs up in order to get young edible shoots artificially, but these shoots are not very nutritious as can be seen from the condition of cattle that feed on such grass.

It is an undoubted fact that it is impossible to really improve our forests if grazing is allowed. It is also indisputable that we, as foresters, are bound to try to get the best possible forest crop from the land in our charge, and therefore when valuable forest areas are being condemned to remain unimproved owing to grazing, it is urgent that *steps should be taken to solve the grazing question.* The application would of course have to be gradual and in many parts grazing will do little harm for centuries to come. On the other hand, we know of valuable areas, which are out of working and cannot be improved because they have to be kept open to satisfy the concessions for grazing for the neighbouring villagers. An annual income of Re. 1 per acre at present, and a possible future income ten or twenty times greater, is being sacrificed in order to give a grant of 2 annas worth of grazing per acre. Whereas the same areas could supply plenty of cut fodder in addition to the timber crop if grazing were excluded.

In all civilised countries, the feeding of cattle on cut fodder is the rule rather than the exception. In parts of India where stall feeding is practised because there are no grazing grounds available, the breed tends to improve, whereas where cheap grazing is available the proportion of useless cattle is extremely large. Mr. Henry, Reader of Forestry at Cambridge, recently said with regard to the increase of pasturage, " To allow good land to lie idle is an offence against God, and pasturage is idleness; it is a reversion to barbarism." "Waste land in Great Britain is a disgrace; it is proof of wasted opportunity on the part of some one." We may well take these sayings to heart in India.

From many provinces complaints are heard that grazing is preventing the improvement of the forest crop. The question is now one of great magnitude; if not dealt with, it will become more and more serious. There is only one solution, since intense forest management and grazing are incompatible. Where valuable forests are concerned we would recommend that the cutting of grass should be allowed at infinitesimal rates and that grazing rates should be gradually made prohibitive. We would advocate also the prescription of an elementary course in all schools to disseminate the knowledge of the beneficial effects of forests on agriculture, water-supply, climate, and soil and of the wastefulness of grazing.

It may be objected that by the time a normal crop is obtained in the forests there will be practically no grass to cut. It will however be centuries before this happens, and by then the growing of fodder crops will doubtless be practised, as it is in parts of India to-day, as well as in all civilised countries.

SCIENTIFIC PAPERS.

BRITISH FORESTRY.

Not until steam had become the bond-servant of man did the people of Great Britain realise the vast amount of energy latent in that accumulation of compressed vegetation which distinguishes the coal measures. They have not been slow to develop those resources. Coal, abundant and accessible, was the chief source of the commercial and industrial ascendency attained by this country during the nineteenth century; and it continues to be the primary requisite in all our principal industries, agriculture excepted. But coal is not the only material indispensable in every kind of manufacture. It has long been matter of concern to many persons, and appears at length to have been reluctantly recognised by the Government, that the ease and rapidity with which profits can be realised by raising fossil vegetation have brought about utter neglect and disuse of the economic cultivation of the nobler forms of living vegetation—an industry in which, if it is once interrupted, the profits are long deferred.

It is impossible to name a single important branch of modern industry in which the use of timber can be dispensed with. Even coal-mining cannot be carried on without pit-props, of which we import enormous quantities from the Baltic; although, as I hope to show, it is only the result of neglecting native capabilities that prevents British requirements from being supplied to a very large extent from home-grown woodland. Orthodox free-traders may look complacently upon a state of affairs in which we depend, practically entirely, upon imported timber for the maintenance of our home industries; but an examination of the statistics of the timber trade, coupled with a notable shrinkage of the visible supply and increasing demand upon that supply by our industrial rivals, may cause some misgiving in the minds of those who care to look a few years ahead. The following tables, compiled from the

Statistical Abstract, show the rate at which timber imports have increased in volume and price during twenty years :—

QUANTITIES OF WOOD AND TIMBER IMPORTED.

Wood and Timber.	1886.	1905.	Increase.	Decrease.	Percentage.
	Loads.	Loads.	Loads.	Loads.	
HEWN :—					
Fir	1,388,278	2,596,078	1,207,800	...	86·9
Oak	95,178	145,663	50,485	...	53·0
Teak	40,895	60,976	20,081	...	49·1
Unenumerated ...	58,411	53,834	...	4,577	7·8
SAWN OR SPLIT :—					
Fir	3,554,769	5,797,922	2,243,153	...	63·1
Unenumerated ...	231,017	188,604	...	42,413	18·3
Staves	130,717	119,182	...	11,535	8·8
FURNITURE WOODS :—	Tons.	Tons.	Tons.	Tons.	
Mahogany	48,732	95,548	46,816	...	96·0
Unenumerated ...	50,717	197,111	146,394	...	288·6
Wood-pulp	117,663	578,012	460,349	...	391·2

N.B.—Dye woods, tanning material, wood-pulp boards, and other forest products are not included in this table.

DECLARED VALUE OF WOOD AND TIMBER IMPORTS.

Wood and Timber.	1886.	1905.	Increase in 20 years.	Increase per cent.
	£	£	£	
HEWN :—				
Fir	2,191,254	3,495,523	1,304,269	59·5
Oak	540,242	875,875	335,633	62·1
Teak	498,257	876,654	378,397	75·9
Unenumerated ...	192,483	225,753	33,270	17·2
SAWN OR SPLIT :—				
Fir	7,813,046	14,469,574	6,656,528	85·1
Unenumerated ...	392,446	785,756	393,310	100·2
Staves	532,117	553,092	20,975	3·9
Wood-pulp	724,955	2,759,627	2,034,672	280·6
FURNITURE WOODS :—				
Mahogany	402,935	820,995	418,060	103·7
Unenumerated ...	407,562	1,170,798	763,236	187·2
Total ...	£13,695,297	£26,033,647	£12,333,350	90·0

It will be noted that in most classes of timber there has been a considerable rise in price, as well as in volume; and that even in those classes which show a diminution in volume, the price has risen so much as to show an increase in the total value. Sawn fir, for instance, which constitutes more than half the total value of our timber imports, has risen 22 per cent in price in twenty years. It may be matter for speculation how many British industries might survive a similar rise in the price of timber during the next twenty years.

Concurrently with the increased consumption by the United Kingdom (amounting, in the case of sawn fir, to 63·1 per cent in quantity and 85·1 per cent in value and that of hewn fir to 86·9 in quantity and 59·5 per cent in value) we have lost some important sources of supply. The German Empire, whence thirty years ago we were drawing a large portion of our imports, has become within that period a vast industrial area, requiring for its own use all the timber it can produce. The gross annual value of the product of German forests is estimated at £22,000,000; yet notwithstanding, the requirements of the Empire are now so urgent that, for some years back, she has been importing about 4,500,000 tons of timber annually, valued at £15,000,000. Germany can now spare no wood for export, except in the shape of manufactured articles. Similarly in the United States, whose timber supply once appeared inexhaustible, and might have proved so but for improvident lumbering, the home demand has risen by leaps and bounds; so that practically that source of supply is closed to us, although we still continue to import timber from Canada.

We in Great Britain, therefore, are now confronted with what has long been predicted—namely, shortage in a material indispensable to sustained industrial activity. Unfortunately, we have waited until the famine is at our doors. Joseph had the foresight to turn seven fat years to advantage in making provision for the seven lean years which were to follow; but we have allowed the fat years to run by, turning deaf ears to those who warned us of coming scarcity. And Joseph's task was comparatively a simple one. He had only to convince the paternal Government of Pharaoh, and

then to deal with a crop the rotation of which was measured by seasons; whereas forestry reformers have had to pester successive free-trade Governments who, avowedly cared nothing for the source of our supplies so long as we got them, to embark upon, or at least to encourage, a form of cultivation whereof the rotation is measured not by seasons, but by generations of men.

Three and twenty years ago, in 1885, the reformers succeeded in inducing the Government to appoint a Select Committee of the House of Commons to inquire "whether, by the establishment of a forest school, or otherwise, our woodlands could be made more remunerative." Two years later the Committee reported strongly in favour of the establishment of forest schools, reflecting at the same time very unfavourably on the management both of Crown forests and of private woodlands in the United Kingdom. They also recommended the establishment of a Board of Forestry. Some slight effect was given to the report of this Committee by the Act of 1889, which empowered the Board of Agriculture to collect forestry statistics, to inspect schools where instruction in forestry was given, and to make grants in aid of lectures and forestry instruction. A beginning was made in 1891 by the allocation of £900 a year apportioned between Edinburgh University, Glasgow Technical Institute, the Durham College of Science, and the Welsh University College of Bangor.

The next step was the appointment, in 1902, by the President of the Board of Agriculture, of a departmental committee to inquire into the position and prospects of forestry in the United Kingdom and to recommend such measures as might seem expedient to promote it. This Committee reported in much the same strain as the former one, but was far more explicit in its recommendation. The report is a well-considered, lucid *aperçu* of the situation, of permanent value to all concerned in the management of Crown or private estates; but space can only be found here for quotation of a single paragraph:—

"The world is rapidly approaching a shortage, if not an actual dearth, in its supply of coniferous timber, which constitutes between 80 and 90 per cent of the total British timber imports. The great

area of waste land in these islands which might be afforested......thus becomes a matter of grave national concern. No individual effort is likely to cope with such extensive afforestation, not only because British forestry, as now practised, is inefficient, but because of the capital required, the time during which it remains sunk before producing income and the lack of all security on private estates for continuous good management from the time that the forest is formed until matured timber is placed upon the market. We do not feel justified in urging the Government to embark forthwith upon any general scheme of State forests under present circumstances; but the question of planting suitable waste lands under the control of the Crown, or over which the Crown exercises manorial rights...... is worth the attention of the Commissioners of Woods and Forests."

The presence on the Committee of a representative of the Treasury is enough to account for their hesitating reference to State forestry; but they had the hardihood to recommend the acquisition of two areas of practical demonstration, one in England, the other in Scotland. Such an area the State already possessed in the Forest of Dean and the adjacent High Meadow Woods, where the Senior Commissioner of Woods and Forests, Mr. E. Stafford Howard, had established in 1897 a regular working plan such as regulates the management of the productive State forests of France and Germany, but of which, down to that date, not a single example could be found in the United Kingdom. In Scotland no advance was made until last year, when the Government purchased the estate of Inverliver in Argyllshire, extending to 12,000 acres; and in Ireland the Department of Agriculture has secured the late Mr. Charles Parnell's estate of Avondale, county Wicklow, with the woodland of Ballyfad adjoining, as a demonstration area and forestry school.

We may conclude, then, that the period of tentative inquiry is past, and that of practical demonstration begun. Already there are encouraging signs of readiness on the part of public bodies to follow the example of the State. A forestry school has been started at Oxford under the guidance of Dr. Schlich and Professor W. R.

Fisher; Dr. A. Henry has been installed in the new readership of forestry at Cambridge; a chair of Forestry has been founded at the Royal Agricultural College of Cirencester, and a lectureship at the Agricultural College of Wye, in Kent. Even more significant of the interest awakened in a lost industry are the efforts now being made to revive it by some of the great municipalities of the north, which have begun to plant upon scientific principles the large catchment areas of their water supplies. Liverpool headed the list at the close of last year with 640 acres planted out of a total of 22,000 at her disposal, and seven other towns show an aggregate of 1,560 acres of young wood. Trifling figures these, compared with the extent of Continental forests, but not discouraging when one remembers the long years when forestry reformers could get nobody to believe that mature timber could ever be produced at a profit in these islands. Nor are these modest figures altogether contemptible when compared with the total woodland area of the United Kingdom, constituting as they do an addition made to that area within the last decade.

Green fields of England ! wheresoe'er
Across this watery waste we fare,
Your image at our hearts we bear,
Green fields of England, everywhere.

And so richly umbraged is that image by hedgerow timber and ornamental woods (the two most wasteful forms of tree growth) that we are accustomed to regard England as a woodland country and to rejoice in its sylvan wealth compared with the apparent treelessness of Italy and Central France (as descried from the window of a railway carriage). It requires the relentless test of statistics to convince us that the United Kingdom has a smaller percentage of woods to other land than any other country in Europe, and a smaller area of woodland to each head of the population.

The following table was compiled by Dr. Nisbet from statistics published by Messrs. Endres and Weber in 1892 and 1903:—

Country.	Woodland area.	Percentage of woods to other land.	Woodland area per head of population.	PERCENTAGE OF WOODS OWNED BY				
				State or Crown.	Private owners.	Church and other endowed bodies.	Municipalities and village communities.	Corporations.
	Acres.		Acres.					
Sweden ...	45,061,984	44·4	9·36	19·9	80·1	...	...	...
Finland... ...	50,359,471	38·0	25·77	71·1	18·9	...	...	...
Russia	447,592,405	36·0	4·58	60·3	29·7	...	...	...
Austria	24,150,215	32·6	1·00	6·5	71·3	7·1	14·9	0·2
Hungary ...	22,683,469	28·3	1·27	16·0	41·3	6·6	18·5	17·7
German Empire ...	34,734,123	25·8	0·67	32·9	47·5	1·3	15·6	2·3
Norway... ...	19,280,820	24·0	10·56	12·5	84·8	2·7	...	...
Turkey, Bulgaria, Bosnia, and Herzegovina ...	15,613,830	22·2	3·50	...	...	...	...	...
France	23,360,062	17·7	0·56	11·1	66·5	22·5	...	...
Spain	20,955,480	17·0	1·27	82·2	17·8	...	...	...
Belgium... ...	1,205,830	16·6	0·10	...	...	...	...	...
Italy	9,030,320	12·0	0·32	3·8	53·8	43·0	...	...
Holland ...	568,100	7·0	0·10	...	...	...	...	...
Denmark ...	508,298	5·4	0·25	...	...	...	...	...
Portugal ...	1,165,346	5·1	0·25	...	...	...	...	...
Great Britain and Ireland	3,029,139	3·9	0·07	2·3	97·7	...	...	...

The substitution of coal for wood as fuel and the high prices which ruled for agricultural produce until thirty years ago are mainly answerable for the utter neglect we have shown to our forest resources. Trees—do we not all love them and lavish upon

them, as ornaments, greater expense and care than any other nation does? But we do so as arboriculturists, not as sylviculturists —as landscape gardeners and botanists, not as foresters. Not only are the two branches of the craft perfectly reconcileable with each other, but they are mutually indispensable. In a future paper it will be shown how the knowledge we have gained as arboriculturists will serve us in re-establishing the science of economic forestry, without sacrifice of landscape effect.—(*The Times.*)

ORIGINAL ARTICLES.

TAUNGYA CUTTING.

Taungya cutting, as I have seen it, would appear to fall roughly into four classes.

The first of these which is distinct from the other three is the ordinary upland cultivation on land where ploughing is possible. The cultivator ploughs a piece of land, takes one or two crops off it and then lets it revert to grass land or scrub jungle for another six years or so. Except that the patches are not arranged systematically, and the period during which the land is allowed to lie fallow is long, the difference between this method of cultivation and agriculture as practised in more civilised countries is not so striking.

The growth of weeds is so much more rapid in Burma that I doubt if the agricultural methods applicable at Home could effectually cope with them, so it would seem a necessity to allow the land to lie fallow for a certain period so that weeds may be killed out by a crop of grass or woody plants.

2. The other three classes comprise taungya cultivation where the nature of the ground does not admit of ploughing and may be sub-divided as follows :—

(*a*) Taungya cultivation where the taungya areas are fire-protected and worked under a fixed rotation. This

method is largely practised in the Karen Hills and in the south-west of the Southern Shan States.

(*b*) Taungya cultivation where the area is not fire-protected but a rotation of sorts is observed.

(*c*) Taungya cultivation where there is neither fire-protection nor rotation, *i.e.*, taungya cultivation in its most primitive form, carried out for the most part in virgin forest.

3. The attitude of the Forest Department is not unnaturally hostile to taungya cultivation in any shape or form, but the fact remains that in the present state of their agricultural knowledge taungya cultivation of some description must be permitted to enable the various people in the hilly localities to live and our various proposals to abolish it altogether in certain areas are generally viewed rather unsympathetically by the powers that be.

Till quite recently the efforts of the Forest Department to curtail the areas used by the taungya cutter were undertaken more in the interests of teak than with a view to the preservation of the forests for climatic reasons. In recent years however the question of protecting our forests for climatic reasons against the inroads of the taungya cutter has come prominently forward and the authorities are less suspicious of our efforts in this direction than formerly they appeared to be. I would submit, however, that the attitude of the Forest Department is still too uncompromisingly hostile to the taungya cultivator. We are not inclined to recognise him as an evil that has to be tolerated. We strive to abolish him rather than to regulate his devastations.

4. To turn to the classification of taungya cultivation given above. The chief evil in the case of the first two groups (upland and fire-protected taungyas) is that the taungya areas, instead of being concentrated in one block, are scattered in small patches over huge areas, each patch being an unnecessarily large distance from that of the previous year and chosen unsystematically, the choice depending on the instinct or superstition of the taungya cutter. Thus where some 50 acres under a proper rotation are required by each individual taungya cutter, he probably scatters his patches

over ten times this area and hacks away the intervening forest, partly to remove shade from his crops, partly on account of his irresistible propensity to hack at everything tree like. Were it not for their scattered nature upland cultivation and fire-protected taungya cultivation would do comparatively little harm.

5. Un-fire-protected taungya cultivation, however, falls into a very different category from either of the above two groups and requires a much greater measure of control as much in the interests of the taungya cutters themselves where they are confined to a restricted area as in the interests of the forests, where a fixed taungya rotation is adopted; if the areas to be cut over are not protected from being annually burnt, the soil deteriorates from year to year, the woody growth which is depended on for manure gets scantier and fails to protect the soil, so that the crops get poorer year by year and probably in course of time the taungya areas become almost completely sterile.

Taungya cultivation without a rotation need not be taken into consideration. There can be no question but that it should be stopped drastically.

6. To properly regulate taungya cultivation in unclassed areas is beyond the power of our present establishment. We may have it stopped in certain areas; but this probably results in the areas not closed to taungya cutting being mercilessly overworked. We may try to restrict the use of fire in the areas where taungya cutting is permitted by prohibitory order; but even if the inhabitants themselves were careful in the use of fire, the areas would be almost certain to be burnt through carelessness of passing wayfarers.

Taungya cultivation in unclassed forest can in my opinion only be properly regulated by a settlement which allots to each village an area where it can cut taungyas. Such a settlement would take time and cost money; but the hills and forests and incidentally the people themselves, though they would not realise it at the time would be bound to benefit by it. At settlement the area required by each village could be roughly marked out and a few simple rules prescribed. Above all, the fire-protection of the area

allotted to each community should be insisted on and an endeavour should be made to gradually concentrate the cuttings of each year. Such areas should come under the care of the revenue authorities. The Forest Department would have enough on its hands looking after the areas of unclassed forests which were not subject to taungya cultivation.

7. To turn to the question of areas inside reserved forests which are subject to taungya privileges, I think we could and should do something to regulate the operations of the taungya cutter. It is the duty of the forester so to manage any forest burdened with rights that it may be capable of yielding whatever produce the right holder is entitled to, and even if taungya cultivation is reckoned a privilege, subject to restriction or abolition at the stroke of a pen, I would submit that it behoves us to attempt as far as we can to keep the areas subject to it in as fit a state for the purpose of taungya cutting as possible. I would further submit that foresters of other countries would adversely criticise our methods if they realised that in some, at any rate, of the areas subject to taungya privileges inside our reserved forests taungya cultivation was allowed to continue in the old primeval manner in which it was practised in prehistoric times.

8. In the Settlement proceedings of certain reserves that were settled in Lower Burma some 20 or more years ago, areas allotted to each village for purposes of taungya cultivation were determined by multiplying the number of taungya cutters in the village by the average area in acres worked annually by each taungya cutter, multiplying the figure thus obtained by the average taungya rotation and doubling the result to allow for areas unsuited for taungyas. The figure thus obtained was taken to represent in acres the area required by each community. The only restriction was that no teak were to be cut or injured in the taungya areas. In none of the areas, that I have experience of, was fire-protection compulsory, though of course fire-protection would have been insisted on had the fire-protection of the rest of the reserve been undertaken and the annual fires have so reduced the fertility of the taungya areas that each Forest Officer that visits the areas has to

listen to long grumblings about the inadequacy of their size. Whereas, if these areas were treated under any system or even fire-protected only, they would in all probability suffice to support double the population located on them. If certain taungya cultivators, such as the Karens in the Karen Hills, recognise that fire protection is beneficial to their taungya areas there can be no doubt that it must be beneficial.

9. I would therefore suggest the following rules for areas subject to taungya privileges inside reserved forests :—

(*a*) That the privilege holders fire-protect the whole area allotted for taungya cultivation.

(*b*) That they observe a fixed rotation for their taungyas.

(*c*) That they gradually concentrate their taungyas for each year in one block.

(*d*) That when putting in a crop in the poorer part of their area where woody growth is scarce, they put in at intervals some quick-growing woody plants, *e.g.*, the common *taung kathit* (*Erythrina stricta*) seems specially suitable. It thrives anywhere and everywhere and has such an extraordinary vitality that any cutting placed anyhow into the ground will probably grow. Such woody plants if put in would protect the soil and serve as a useful manure at the next cutting.

10. Some such regulations seem absolutely necessary where taungya cultivation has to be permitted in reserves formed on high hills for the protection of the water-supply or for climatic reasons. The result of their application would cause the taungya areas to resemble to a certain extent a forest managed under a clear cutting system on a short rotation. If the areas are fire-protected the percentage of the soil exposed at a time would be much less than if they were not protected from fire and the damage done by the taungya cutter would be reduced to a mininum.

11. To prevent the regulations from becoming a dead letter or to enforce a taungya rotation on communities that have never observed one, the area subject to taungya privileges could suitably

be divided into a number of compartments of approximately equal area to correspond in number with the years of proposed taungya rotation, each compartment being demarcated by rough blazing and the privilege holders could each year choose which block they liked for their taungyas, provided they did not return to it till its turn came in the second rotation. Departmental fire-protection might be undertaken for the first few years to teach the people how to fire-protect their area.

12. I have written the above for the purpose of eliciting information as to whether any attempt has ever been made to systematise taungya cultivation and also for favour of any suggestions that may be made. I am at present assisting at the settlement of an area of some 850 square miles with hills running to over 7,000 feet that is about to be reserved for climatic reasons. This area contains some 1,400 Palaungs, a race that cannot live at low levels. These Palaungs have to be provided with taungya areas inside this reserve. They have already done an incredible amount of damage, cutting without a rotation and in virgin forest by preference. The forests at the high altitudes were mostly pine and taungya cutting has caused large patches to become treeless grass land and has materially affected the water-supply.

If taungya areas are simply formed in the usual way without regulations being insisted on, I have little double that in at most another two decades the Palaungs would convert them into unproductive wastes incapable of supporting any population.

CAMP, SOUTHERN SHAN STATES: H. W. A. WATSON,
15th February 1908. *Deputy Conservator of Forests*

I.—RESERVES.

Settlement proceedings.

1. In the United Provinces nothing beyond the bare record of rights or privileges as sanctioned, and the final orders of Government, have ever been printed, for the great majority of the reserves. The consequence

is that there are now no records available of the actual settlement proceedings.

In Burma, a far better plan is in operation. All important papers with regard to preliminary proposals for reservation, Forest Settlement Officer's proceedings, forest and other appeals, the final orders of Government and (in many cases) final demarcation reports are printed, and a liberal supply of copies is filed in Divisional Forest Offices. Bound into books, they form permanent records that are easily accessible. To them are also added in printed form any subsequent proceedings there may be on the same subjects.

Size of reserves.

2. The unit of permanent settled forests belonging to the State in India and Burma is the "reserve." Very different methods of procedure appear to have been followed in different provinces with regard to the selection of these units. In the United Provinces a continuous tract of forest, which it was thought desirable and feasible to reserve, was taken up as a whole, as a single reserve, so long as it came within the limits of a single civil district. The size of the tract made no difference whatever. It was treated as one reserve. So much for legal position. After reservation came sub-division into blocks and compartments for purposes of examination, and into divisions, ranges and beats for purposes of management. Hence it is that in ordinary forest business the word "reserve" is not used to anything like the same extent that the word "block" is used. For a variety of reasons, most of the divisions in the United Provinces have the whole or parts of several reserves in them, but, in actual working, very little attention is paid to the fact.

3. In Burma a very different state of things exists. Every division contains a large number of reserves (rarely less than a dozen), the majority of these units are small in area, and each of these reserves is, quite as a matter of course, treated as a unit for working and management.

A certain number of reserve units are unavoidable and desirable. All reserves in a district are not taken up at one and the same time. There is however cause to regret that Forest Officers in early days tried to combine two ideas which have no essential

connection with each other—the legal unit and the working unit. For this reason, whenever it was proposed to reserve a tract of, forest it was first of all divided into blocks, thought to be the best for working purposes, and each of these blocks was then proposed, enquired into, and settled as a separate reserve. Again, for many years whenever extra bits of forest adjoining existing reserves were taken up, they were treated as separate reserves. Recently, indeed, Government has ordered that this procedure should be changed and that such additions should be absorbed in the older reserves.

4. Examples of simultaneous reservation of several reserves forming continuous tracts of forest can be found in most divisions. Two may be referred to. In the Magwe district is a solid block of forest 400 square miles in area, known collectively throughout the whole country-side as the Taungdwingyi reserves, but legally made up of six different reserves. The whole lot were proposed at one and the same time by one officer. Incidentally I may note that an interval of six years elapsed between the completion of the settlement of the first and last of the series. Had the whole been treated as one from the beginning, two years would probably have been found sufficient. The hill forests in the Tharrawaddy Division are another good example. The reserves are all in one long block of about 300 square miles and they were all taken up together, and yet not as one reserve, but as five, varying in size from 25 to 108 square miles. Four subsequently formed reserves of small extent in these hills I leave out of account, as well as four others outside the hills.

The annual returns for 1903-04 show that in that year there were 440 reserves distributed amongst 26 divisions, or an average of 17 reserves to a division. The total area of reserves was 19,709 square miles or an average of 45 square miles per reserve. The reserves varied in size from 1 to 460 square miles, and 292 (or 66 per cent) were less than the mean of 45 square miles.

Amalgamation of reserves.

5. This excessive multiplication of units is to be regretted. A good deal of the delay in taking up forests has been due to it, and it is a constant source of worry and trouble to all concerned in the management of

the forests. Would it not be a step in the right direction to re-gazette all existing reserves in groups of two or three for each division, and henceforth discontinue the treating of them as separate units? The labour involved would be trifling and the gain would be considerable.

Demarcation.

6. Another direction in which there is room for improvement is in the selection of boundaries to reserves at settlement. The initial cost of permanent demarcation (and the cost of subsequent repairs), facilities for inspection and protection, and the relation of the boundaries to the general management of the forest should constantly be borne in mind. It is not good enough to think simply of the legal aspect, and the satisfaction of village claims, at the time of settlement. It is hardly likely that anyone else will take the initiative in bringing other matters to the notice of the Forest Settlement Officer if the local Forest Officer does not do so. Examples of cases in which demarcation is unduly complicated are only too common. The case of the Thindawyo reserve in Tharrawaddy may be mentioned as one instance. This is a small block of 10 square miles outside the hills and surrounded by paddy fields. In shape it is practically square, and on a 1 in. scale the sides look quite straight, and yet there are such a number of minute twists and turns that 427 posts are required to demarcate the boundary of 13 miles.

Twenty years ago many of the reserved forests in Oudh were in very much the same position. They were demarcated by a multitude of posts, in many places so close together that they could hardly be shown on the 4 in. maps.

About 1892, it was decided to introduce a more permanent form of demarcation with stone pillars instead of posts. Before this was done, however, the boundaries of several reserves were considerably simplified and shortened by exchanges with neighbouring land-owners. I can call to mind several instances of straight line boundaries 2 to 4 miles long (demarcated by 8 pillars to the mile) replacing zig-zag lines, 4 or 5 times as long, and requiring an average of 20 or 30 posts to the mile. Even where, therefore, the original demarcation was defective the improvements

effected in Oudh show that such defects are not in all cases perpetuated.

7. In hilly country, where boundaries do not follow natural features, particular care is required in their selection. For inspection it is necessary that such boundaries be * accessible and that a road or path should run along them, but I know of nothing more fatal to having a good boundary, than for it to follow a village path or cart track. It is simplest and easiest at the time of settlement to make use of an existing track as a boundary, but in ninety-nine cases out of a hundred a good road can never be got along such a track. If a properly aligned road is afterwards made it will twist in and out of the reserve. In such cases, it would have been infinitely preferable to have laid out a good road line first of all and have taken it as the boundary. Such a suggestion is not so impracticable as it may at first sight appear. The local knowledge of the Forest Officer deputed to assist the Forest Settlement Officer should enable him to decide where roads are likely to be useful, as well as what points are obligatory and what gradient to work for. Given these data it is no great task to peg out half a mile a day with an Abney's level in difficult country. Beyond putting posts at intervals nothing more is necessary for purposes of first demarcation. Even if a road of full width is out of the question for some years, yet the posts can be readily connected by an 18-in. path along the line of pegs. If all bamboo clumps and trees that come in the way of this line are rooted out, and if bamboos and trees within 5 feet on either side are cut back, there will be a path that can be used for riding and even for baggage elephants, except on steep slopes. Of course I do not wish the suggestion, that boundaries should follow road lines, to be taken too literally. If posts are put at outer angles of the road line it may be convenient to have a straight line between them as the boundary. There is no objection to this provided such lines are short. The essential point is that all posts bear a definite relation to the road line.

* Straight line cross-country boundaries in the hills look well on paper, but they are very bad to have anything to do with, and are not to be recommended at any price.

The point about such demarcation and road work is that none of it is wasted and none of it has to be undone in the future. Can this be said of the apologies for roads and paths that are only too common in many divisions?

If any one still has the idea that good roads or paths in the hills can be aligned without the use of instruments (such as the Ghaut tracer or Abney's level) the sooner they disabuse themselves of the idea the better. It is impossible.

Enclosed village land.

8. Comparison of the maps and records of rights of reserves in the United Provinces and in Burma would generally bring to light one striking difference. In the former, it is common to find demarcated village lands—generally fields—included within the outer reserve boundaries, although not forming part of the reserves themselves. In Burma it is rare. It appears to have been the rule to push back the reserve boundary at settlement so as to exclude nearly all village land, thereby sacrificing much forest. There are arguments for and against both plans. Personally, I incline to the Indian plan. Even though the enclosed land may be numerous at first, yet it is often possible to acquire some or all of them in later years.

Grazing.

9. It is the exception, rather than the rule in Burma, for reserves to be heavily burdened with grazing rights. This follows naturally from the course, so often adopted, of excluding sufficient forest for the actual and prospective requirements of villagers. Had the tracts thus excluded always remained as forest there would be no need for comment. The trouble is that, in some instances, they have almost entirely disappeared under the plough. The result is that the villagers have to look to the reserves for their requirements. For timber and firewood this is not generally of much moment, but the necessity for providing for grazing is a different matter, and may seriously interfere with the proper management of the forest.

Thindawyo is again a case in point. The rectilinear shape of the reserve, and the absence of recorded rights in it, point to the

fact that it was a relatively small block cut out of a large area of forest when taken up in 1875. In the interval, cultivation has extended right up to the very edge of the reserve all round. The forest swarms with cattle in the rains. There is nowhere else for them to go, with all the country-side under paddy. Under the circumstances I doubt very much the possibility of giving full effect to the provisions of the recently sanctioned working plan. We may indeed be faced with the necessity of treating it primarily as a grazing ground.

The argument is that the Forest Officer should take a strong interest in the grazing question, at any rate in so far as it affects the forest in the neighbourhood of his reserves. Obviously, whenever a tract of forest is excluded from a reserve on the ground that it is required for grazing, it is a strong argument for the necessity for its retention as forest. How can this be better done than by reserving it.

II.—WORKING PLANS AND WORKING CIRCLES.

Working plans.

10. Sub-division into a large number of small reserves would not have mattered so much, if it had not been taken more or less as an axiom, in Burma, in the past, that each reserve should form a separate working circle, and have a separate working plan for it. I cannot call to mind at the moment what is the official definition of the limits of a working plan, but I take it that only one plan is needed for all forests of the same character and supplying the same markets. It does not matter in the slightest whether the tract dealt with is made up of one or of a hundred reserves, except in so far as private rights may interfere with freedom of working.

Tharrawaddy may be quoted again as an example. Because the hill forests were constituted as five different reserves, therefore five separate working plans were made for them. The first was written by one officer in 1884, another officer wrote three more in 1885, and the fifth was written by a third officer in 1888. All deal with the same type of forests, supplying the same market; all prescribe the same method of treatment, and yet the unfortunate

Divisional Forest Officer has to make frequent reference to all five of them to see if there are not minute differences in details.

Perhaps it would be as well for me to pause here and state that in criticising the scope and arrangement of these plans, I have no desire whatever to belittle the work of the men who compiled them. The plans were amongst the first made in India or Burma, and, as such, are entitled to respect. Still, the authors of these plans would be willing to admit that the plans are not perfect, and it is only reasonable to suppose that ideas should have changed considerably, as to the working of the forests, in the quarter of a century that has elapsed since the plans were compiled.

With this explanation, I desire to point out that one plan would have done just as well in 1885 as five plans. The descriptive chapters in any one of them plus the five girdling tables and the detailed descriptions of compartments would have served the same purpose and would have been far more convenient. The perpetually over-worked state of the Divisional Forest Officer is the sole reason, I suppose, why the plans have not hitherto been condensed in this way.

In the United Provinces it has long been recognised that a working plan is not as a rule required for each reserve. For a variety of reasons there are a number of reserves in each division, but in the majority of cases, there is only one working plan.

Working circles.

11. So far, I have assumed as sound, the formation of the different reserves as working units or working circles, although pointing out that they might very well have been grouped together into a smaller number of working plans. The argument that the large number of reserves or working circles was and is necessary now requires examination. Are the blocks thus formed, the best for working purposes? In the case of Tharrawaddy I very much doubt it. To begin with, if the contention was correct, the several blocks should have been of approximately the same size, or have yielded approximately the same outturn. But neither was nor is the case. The boundaries of the reserves follow natural features and they simply represent the drainage basins of the five principal rivers which rise in them. They

vary in size from 25 to 108 square miles. In the smallest, only 250 trees have to be girdled annually, and in the largest 1,000 trees. If 108 square miles was not too large for one, why not have clubbed together the others into two at most? Again is 108 square miles and 1,000 trees the largest unit possible for working? This depends on the capabilities of the floating streams, as they should not become congested with logs. In 1906-07, 2,774 trees were felled in and 5,506 logs were floated out from all five of the reserves. Officers of longer experience of the district than myself will, I think, bear me out in the opinion that this number of logs could easily be accommodated in any one season, in any one of the five streams giving their names to the reserves.

12. The above remarks narrow themselves down to this that in Tharrawaddy, whatever may have been the necessities of the case in the past, there is now no longer any need whatever to have even five working circles. A single plan with a single working circle would be sufficient. The gain would be immense. Instead of having girdling, fellings and subsidiary operations going on simultaneously in five different places, they would each of them be confined to one locality. At present it is impossible for the Divisional Forest Officer to personally inspect all the works going on in the division. By concentrating them, it would be less impossible for him to do so. Again, one reason why so few good roads exist in the forests is that the areas are so large and work is going on everywhere. By having the greater part of the work of the year in one block only, there would be more chance of good roads for inspection purposes being made; thereby tending to a more economical utilisation of the services of inspecting officers.

A provincial working plan.

13. It may, perhaps, be urged that the idea is impracticable, but before closing, I should like to carry the argument a step further. Why stop at the forest division as the unit for working plans in Burma? Why not include the whole province in one plan? The idea is not a new one. For the whole of Burma there is, in effect, one working plan for the supply of *Pyinkado* sleepers to the Burma

Railway Company. For the first five years fellings are confined to five divisions, thereafter they will move on to others. There are five working circles in fact.

The case for teak is on exactly the same footing. All divisions have one or other of three markets—Rangoon, Moulmein or Mandalay—for the most valuable part of their timber. All divisions have much the same types of teak forest in varying proportions; and no such decided differences in the rates of growth in the different parts of the province have been discovered, as to call for considerable differences in the choice of felling rotations. I take it that it would be physically possible to work out all the forests in any one division in 10 years, instead of the usual 30 years. That would mean not more than one working circle to three divisions; total something like nine for the province. If the annual averages of area and number of trees for the first five-year period were made equal to what they now total for the whole province, we would be quite as safe in working as we now are with our microscopic reserve units. Before the second period began more figures would be available.

III.—CONTROL FORMS AND JOURNALS.

14. The registers of control forms in Tharrawaddy would make a good load for two coolies and the reserve journals would be plenty for a third man. The result is that a good deal of their value to the Divisional Forest Officer is lost because he can rarely find it convenient to take them into camp with him. The argument for having as few working circles as possible applies also to these books. With the prescriptions of plans for, and the results of operations in a division distributed piecemeal over 10 books (for Tharrawaddy, say), how is it possible readily to control working? The annually recurring batch of correspondence between the Conservator's and Divisional Forest Offices, with regard to discrepancies, is sufficient evidence of the difficulty in doing so.

Control forms.

It is not indeed, as though the trouble were only an annual one. It crops up every month when passing accounts. A road is made

through two working circles; a house is built on the boundary between two, or, perhaps, it is outside the reserves altogether; logs from several reserves are sold in a lump together, and so on. Is the distribution ever correct? Are the figures obtained ever likely to serve any useful purpose commensurate with the trouble and time involved in compiling them? I doubt it very much, for the multitude of small working circles in the province.

Journals.

15. In order to extract from the journals of such a division as Tharrawaddy all the observations recorded and deductions made on any one subject by successive officers, it is not only necessary to have recourse to half a dozen books, but it is obligatory to read through the whole of each book, as it is the custom to put all notes and figures for a year together. The results are sad. The weight of the books precludes their being frequently taken into camp, and the system of entry more or less limits the addition of notes to the end of the year. The system seems to me wrong. The annual report gives readily the history of the year under all heads. The journals should gives readily information collected under any one head in a number of years.

Conclusion.

16. It is a sound rule in practice that existing arrangements should be left to run their course unless very decided advantages are expected to result from re-arrangement. How does this apply to the fusion of reserves, working plans and working circles suggested in this article? Am I solitary in the opinion that the advantages of re-arrangement far outweigh the disadvantages? I doubt it. A point worth inviting attention to is this—a felling rotation of 30 years is not a very long period in the life history of a teak forest, and so the argument may be advanced that it would hardly be worth while to make any changes until the first period had run its course. True, but 30 years is a very long time in the working life of a Forest Officer. Very few men live to put in 30 years' service at all, and very few men have much to do with the same forests in the second half of their service, that they had a hand in the management of, in the first half. It must be rather disheartening to

a man to know that, during his four or five years' tenure of a divisional charge, a good deal of his time will be taken up uselessly, because the plan or plans he has to carry out are certain not to be permanent. The fact of the matter is that whether the authors of the earlier plans thought they would be permanent or not, the plans themselves have been too much treated as though they would be so. The swing of the pendulum has in recent years set in the opposite direction. This has happened from a variety of causes. One important reason is that some of the apparently axiomatic articles of our belief (or training) have begun to be questioned. The universal application of protection from fire is one instance. Another is the method of treatment itself. It used to be taken for granted, that "selection" was the only method possible for the bulk of the forests in India and Burma, and that it left no room for improvement. Now, the possibility and desirability of following a regular system with or without artificial regeneration on a large scale is under investigation. The official papers published in the December *Forester* show this.

Whilst, therefore, bringing our forests as quickly as possible under working plans, let us re-adjust our ideas with regard to the latter, and make revision after short periods the rule rather than the exception, and keep ever in view the possibility of the fusion of plans for contiguous forests.

In conclusion, may I only add that I have contrasted procedure in two provinces with no idea whatever of running one down at the expense of the other. I have seen something of forest management in both, and my notes may be of use to other officers who have not. A variety of subjects have been touched upon—some of them of importance. It would be a pleasure to me to find other officers making public their views on the same or similar subjects.

THARRAWADDY: F. A. LEETE.
8th February 1908.

MACARANGA DENTICULATA MUELL. ARG.

(EUPHORBIACEÆ).

Macaranga denticulata is a small evergreen tree found growing gregariously in the Dooars. It attains a height of 40 to 50 feet with 3 to 4 feet girth. It is a very quick growing species, growing 30 to 40 feet high in 8 to 10 years and the height growth is completed in 10 to 12 years. The wood is white, light, very soft and good for nothing; it burns very quickly, so it is not much used for fuel in the tea gardens. The poles, which are very straight, are used in the tea gardens for coolie-line posts and locally for fencing in the fields. They last for three or four years if not exposed to sun and rain; if exposed, they decay very quickly and do not last more than a year or two.

In forests where the climate is like that of the Dooars, this species can give invaluable help in many important operations; as, for instance, it may act as a nurse for more important species and also may assist in protection from fire and in filling up of blanks. Grass lands have been and are being filled up naturally with this species in this locality. The seeds which are globose in shape, can easily reach the soil even in very thick grass. They germinate in the rains, and if the area is carefully protected against fire for about 3 or 4 years, the seedlings grow up to the height of the grass, *i.e.*, 6 to 10 feet high, and its utility then becomes apparent. Though a fast growing species, the plant is fairly hardy and it coppices very well. It grows in plains as well as on hill sides up to 4,000 feet elevation, in dry stony as well as in moist clayey and even in swampy soils, in open blanks as well as in shady places. It thrives better in open, dry, well-drained soil. From the fourth to the tenth year of its life it has very thick foliage, scarcely admitting direct sun light to the ground underneath. As the tree grows on the leaves become smaller and smaller while the shape of the crown remains the same, corymbose, thus admitting gradually increasing light to the ground underneath until it dies, when the soil gets full light. In this way it may be used as a nurse for more important species and also for filling up

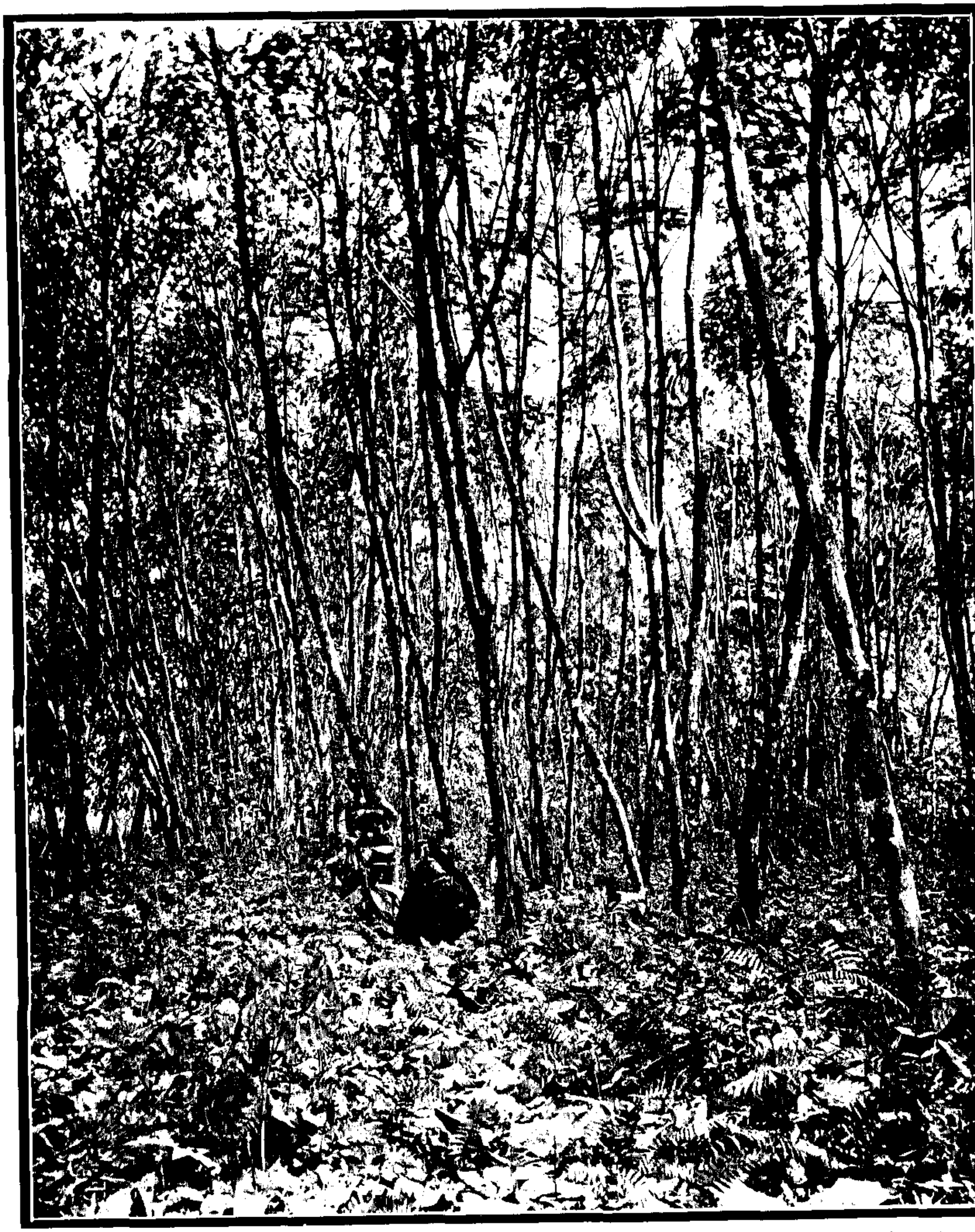


Photo. Mech. Dept. Thomason College, Roorkee.

Photo. by B. Sen Gupta.

Internal appearance of a young Forest of Macaranga denticulata—
the same forest as in Plate 12.

blanks where other species are difficult to start. Green pigeons and other birds like the ripe fruits, and they scatter the seeds all round. In a few years the neighbouring grassy blanks are found covered with a thicket of pure *Macaranga* poles with no vegetation of any kind—not even grass—underneath. They grow on, spread their branches, give gradually increasing light to the soil until they die, and other species gradually make their appearance in the prepared soil.

There is one pecularity in the species, that the branches of the trees do not intermingle with one another however close the trees may grow; when the branches meet, they die and fall off, giving the crowns a peculiar undulating shape like that of mountain ranges as seen from long distances. The interior looks somewhat like a huge tent with a cover of green foliage and posts to support it.

The plants may be used to aid protection from fire. The seeds may be sown broadcast without any preliminary preparation of the soil, but in grassy areas it is best to burn the grass first. The cost is practically nothing. It is necessary, however, to protect the area for a few years from fire.

Mr. Trafford, Deputy Conservator of Forests, introduced the system of growing these plants along the roads, boundaries and fire-lines in Jalpaiguri Division. Every year part of the lines is to be sown, and when the seedlings grow up, it is expected that the lines will remain throughout the year under complete shade and free from grass or herbaceous growth; thus the cost of the annual clearing will be saved.

Plate 12 shows the general appearance of a patch of young *Macaranga* forest 8 to 10 years old, and Plate 13 shows how the interior of the forest is clear and void of any vegetation.

GAIRKATTA: *The 5th March* 1908.

B. SEN GUPTA,
Forest Ranger, Jalpaiguri Division.

[Our contributor is unable to inform us whether this species can withstand frost. We have asked him to send us some seeds so that it may be tried in the grass plains of Oudh. He informs us that the trees die at about 30 years of age.—HON. ED.]

CURRENT LITERATURE.

INDIAN FOREST RECORDS,* Vol. I, Part I.—The first number of the Indian Forest Records appeared in January. It is an exhaustive note on the Lac Insect (*Tachardia lacca*), its Life History, Propagation and Collection by E. P. Stebbing, F.L.S., F.Z.S., F.E.S., Imperial Forest Zoologist.

The importance of this subject may be gathered from the fact that exports of this product from India during 1905-06 exceeded three crores of rupees or two million pounds sterling. The further fact that very little forest revenue is derived from lac is significant in showing that a vast source of revenue in the reserved forests is awaiting development. The first essential towards this aim is that the life history of the insect should be thoroughly understood. Next it is necessary to know the best method of propagation, and lastly the most suitable season for collection.

The author first deals with the origin and nature of lac, the history and growth of the industry. He then treats of the insect itself and its life history. Other chapters are devoted to the food plants—the enemies of lac—distribution—method of cultivation and propagation—exploitation—steps necessary to improve the cultivation of lac—steps to be taken to improve the collection of lac—steps to be taken to increase the production of lac—industrial uses of lac—quantities of lac and lac-dye exported. This note on lac embodies all that is known at present on the subject. It will be of great service to forest officers and others interested in this industry and should be a material aid in the development of lac cultivation in reserved forests. We congratulate Mr. Stebbing on his excellent monograph; the subject is well worthy of the position it occupies as the first part of the newly instituted Indian Forest Records. We must mention that two good plates accompany the text.

FOREST BULLETIN NO. 11.† ON SOME ASSAM SAL (SHOREA ROBUSTA) INSECT PESTS.—This Bulletin by E. P. Stebbing, F.L.S.,

---

* Published by the Superintendent of Government Printing, Calcutta. Price, Rs. 5 per vol. or Re. 1-4-0 per part.

† Published by the Superintendent of Government Printing, Calcutta. Price Re. 1-10-0 or 2*s*. 6*d*.

F.Z.S., F.E.S., Imperial Forest Zoologist, describes all that is known at present concerning the insect pests which damage the *sal* in Assam. In addition to the information previously known many new facts have been elicited and several new pests have been described. Mr. Stebbing also gives notes upon some insects which were found to be predaceous and parasitic upon the *sal* pests. The hand-book is a valuable one, especially to those who are interested in *sal* and will be a great aid to those who wish to study in order to further our knowledge regarding *sal* pests. The Bulletin contains eight excellent plates.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA. BOTANICAL SERIES, VOL. II, NO. 4.*—In this number C. A. Barber, M.A., F.L.S., Government Botanist, Madras, continues his Studies in Root Parasitism, the subject this time being the Haustorium of *Olax scandens*. We are unable to refer in detail to the studies but we must note the interesting fact that as in the case of *Santalum album* many of the haustoria of *Olax* are self-attached. In such, Mr. Barber states that fusion of the tissues is the rule; but this is not all, for there is a great difference between these self-attached haustoria and the ordinary ones attached to the roots of the host, a greater difference than that between such haustoria of *Santalum*. Twelve clear plates illustrate the subject.

THE BOTANICAL GAZETTE † FOR FEBRUARY 1908.—There are two articles in this monthly of supreme interest. In the November issue of the *Indian Forester* we published an article on soil fertility which it will be remembered referred to the undoubted existence of toxic substances in soils. To those who are desirous of pursuing this subject, we strongly recommend the article on. The Toxic Action of Certain Organic Plant Constituents by Oswald Schreiner and Howard S. Reed.

Mendelism has of late years attracted much attention among biologists, and indeed the subject is of absorbing interest. George H. Shull contributes to this number of the Botanical

* Published by Messrs. Thacker, Spink & Co., Calcutta. Price, Rs. 2-8-0.

† Published at the University of Chicago Press. Subscription, 5 dollars per annum. The price of single copies is 50 cents.

Gazette an article entitled Some New Cases of Mendelian Inheritance.

Another article of importance is W. J. V. Osterhout's The Antagonistic Action of Magnesium and Potassium.

THE SCOTTISH GEOGRAPHICAL MAGAZINE FOR MARCH 1908.—The article on Economic Geography by Geo. G. Chisholm, M.A., B.Sc., is full of interest and is well worthy of the attention of our readers. The Geographical Distribution of Labour by H. Crawfurd Angus also deals with a most important subject. The author states that in the progress and development of nations there is no factor which is of greater importance than that of unskilled or raw labour—the human bone and sinew of the world—and the nation which can bring to the carrying out of its plans of progress a plentiful, cheap, and at the same time suitable supply of human energy, must assuredly outstrip in the race of progress the inhabitants of a country where the supply of labour is irregular, unsuitable, and dear. C. E. D. Black contributes an account of Count de Lesdain's Travels across Asia, which describes the notable journey which the Count accompanied by his wife accomplished in 1904-05 from Peking to India *viâ* Sining, Ansichow, Tsaidam, Gyantse and Sikkim.

EXTRACTS FROM OFFICIAL PAPERS.

FORESTRY AT OXFORD UNIVERSITY.

ANNUAL REPORT OF THE DELEGATES FOR INSTRUCTION IN FORESTRY FOR THE YEAR 1907.

Instruction in Forestry was continued throughout the year on the lines indicated in the Report for the year 1906, with such further development as became advisable from time to time. The course of study for the Diploma now comprises the following subjects :—

During the first year : Chemistry of Soils and Organic Chemistry, General Botany, General Geology, Geometrical Drawing and Forest Engineering, Forestry (comprising Silviculture and Mensuration), German.

During the second year : Forest Botany, Forest Zoology, Surveying, Forestry (comprising Management, Protection, Utilisation and Administration of Forests), German.

Additional subjects for Probationers for the Indian Forest Service: Systematic Botany of Indian Trees, Geology of India, Forest Law.

During the third year : Practical Course on the Continent.

Examinations for the Diploma in Forestry are held about October 1st in each year, in General Botany, Forest Botany, General Geology, Forest Zoology, and Forestry. The proficiency in other subjects is ascertained by examinations held by the Instructors.

The attendance during the year was as follows :—

	Hilary Term.	Easter and Trinity Terms.	Michaelmas Term.
First-year Students	26	27	21
Second " "	15	15	26
Third " "	13	13	13
Total	54	55	60

Of the twenty-one new Students who joined in October 1907, nineteen are for service in India and two in Ceylon. The Secretary of State for India has announced that he will nominate sixteen additional Probationers for the Indian Forest Service in July 1908.

Excursions.

The first and second-year students repeatedly visited Bagley Wood and Forest Garden, Tubney, and the Parks. Excursions were made during Term-time to the Woburn Woods, Windsor Forest, Coopers Hill Experimental Plantations, Lord Bathurst's woods at Cirencester, the Earl of Buckinghamshire's woods in the Chiltern Hills, the chair factories at High Wycombe, the Prince's Coverts near Oxshott, and to Dropmore to inspect the fine collection of conifers.

At the close of Trinity Term, the first-year students proceeded on a three week's excursion to France, visiting the coppice-with-standards woods of St. Amand and Raismes, as well as some neighbouring Scotch pine woods ; the high forests of beech, oak, and hornbeam at Retz ; the forests of Compiègne, where game abounds ; the Nancy Forest School ; and the silver fir, spruce, and beech forests at Celles, Raon-l'Étappe, and Gérardmer in the Vosges

mountains. Mr. Fisher reports that the note-books of the students are satisfactory, with two exceptions, and that he places—

In the First Class	4	Students
„ Second Class	5	„
„ Third Class	14	„
Unclassed	2	„
Total	25	„

Practical Course.

Thirteen students completed the practical course at the end of Trinity Term and received the Diploma in Forestry. They were appointed Assistant Conservators of Forests, eleven in India and two in the Federated Malay States.

Twelve third-year students commenced their practical course on October 10th, 1907. They were placed as follows :—

At the Oberfoersterei, Lauenau, near Hanover ...	2
„ „ Salmünster, Hesse-Cassel ...	2
„ „ Dillenburg, Nassau ...	2
„ „ Schotten, Vogelsberg ...	2
„ „ Eberstadt, Hesse-Darmstadt ...	2
„ „ *Heppenheim* „ „	2
Total	12

Mr. N. W. Jolly, Balliol College, completed the whole course of instruction in two years, having taken the practical course in instalments during the vacations. He received the Diploma in Forestry in October 1907, and joined the Burma Forest Department.

Mr. R. L. Robinson, Magdalen College, is also taking the practical course in instalments, and he expects to complete it by September 1908. Four of the second-year students are following a similar course.

Examinations.

An examination for the Diploma was held in the last week of September 1907, with the following results :—

One student passed the first and second examinations.

Eleven second-year students passed the first examination; two second-year students failed each in one subject; these will come up again in September 1908.

Eighteen first-year students passed in Geology.

Degrees.

The present third-year students obtained the following degrees in the Honour School of Natural Science :—

First Class.

Glover, H. M., in Geology	1907
Jolly, N. W., in Physics	1906
Robinson, R. L., in Geology	1907
Smythies, E. A., in Geology...	1907

Mr. R. L. Robinson gained also the Burdett-Coutts Scholarship in Geology.

Second Class.

Gaunt, C. C., in Botany	1907
Ramaienger, R. V., in Botany	1907

Third Class.

Clear, T., in Chemistry	1907
Dawkins, C. G. E., in Geology	1905
Gibson, H. S., in Chemistry	1906
Hepburn, J. K., in Geology	1907
Wilson, C. C., in Geology	1907

Fourth Class.

Miller, W. H. A., in Chemistry	1903
Milroy, A. J. W., in Physiology	1905

FOREST GARDEN AND EXPERIMENTAL PLANTATIONS IN BAGLEY WOOD.

The nursery of one and a half acres, laid out in the winter of 1905-06, has been kept in good condition. In addition to the thirty-two kinds of seed sown in the spring of 1906, the following seeds were sown in the spring of 1907: Corsican pine, Scotch pine, Weymouth pine, European larch, Japanese larch, Norway spruce, Oregon Douglas fir, English and Turkey oaks.

Large numbers of one-year-old seedlings, raised from the seed sown in 1906 were pricked out in the nursery.

The following plants were disposed of:—

To St. John's College, for planting on the College estates.

Weymouth pine, four years old	... ...	2,050
Douglas fir, four years old	... ...	536
	Total ...	2,586

To the Commissioners of Woods, for planting at Tintern Abbey.

Spruce, four years old	... ...	20,000

To Lord Berkeley, for planting on Foxcombe Hill.

Spruce, four years old	... ...	3,500
Corsican pine, four years old	... ...	6,000
Weymouth pine " " "	... ...	5,800
		15,300

To Mr. J. S. Gamble, in exchange for 700 Deodar.

Douglas fir, four years old ...	... ...	1,300

Experiments with artificial manure have been made in the nursery, the results of which will be recorded in next year's report. Basic slag, sulphate of potash, and sulphate of ammonia are being used.

The three-acre plot adjoining the nursery was divided into twelve parts of a quarter of an acre each, and planted with Deodar, Sitka spruce, Corsican pine, Weymouth pine, Oregon Douglas, Colorado Douglas, Norway spruce, silver fir, Siberian larch, sessile and pedunculate oaks, while one plot is covered with naturally regenerated English oak. All these plants have come on very well.

A further area of five acres, placed by St. John's College at the disposal of the Delegates, was cleared of underwood, leaving a limited number of standards of oak and chestnut. This area was planted in the autumn of 1907 with a variety of trees, as English oak, five and two years old, sessile oak (obtained from the Spessart in Bavaria), American red oak, English ash, American ash, sycamore, Norway maple, sweet chestnut, walnut, wych elm, English elm, beech, Lawson's cypress *Cupressus macrocarpa*, plane, and

Colorado Douglas. The plants used in these operations came partly from the Delegates' nursery, partly from that of St. John's College, and some were bought.

As indicated in the Report for 1906, these experimental plantations, together with those already made by St. John's College, will form the nucleus of an important auxiliary in the study of economic forestry.

ACCOMMODATION.

The want of accommodation is about to be met by the great generosity of St. John's College. A block of building for the accommodation of the Professor of Rural Economy was erected in Parks Road during the years 1906-07. It is now proposed to add further accommodation for the forest branch, consisting of a lecture theatre, a class-room, a museum, a library, and a Professor's room. It is expected that this additional accommodation will be ready for occupation by the end of 1908.

POWERS OF LOCAL GOVERNMENTS TO GRANT LEAVE TO CHIEF CONSERVATORS AND CONSERVATORS.

Government of India's Circular No. $\frac{6}{34\text{-}1}$ *F., dated* 18*th February* 1908, *to all Local Governments and Administrations (except Madras and Bombay).*

The Government of India have recently had under consideration the desirability of altering the existing arrangements in respect to the grant of leave to Chief Conservators and Conservators of Forests.

2. Under Article 67 of the Forest Department Code, the Government of India alone grant leave to such officers and all applications for leave must be submitted to that Government through the local Governments, Foreign States or Colonies concerned, in order that timely arrangements may be made for filling up the vacancies thus created.

3. It has been suggested, however, that some saving of correspondence would be effected if local Governments were empowered to grant leave to all Chief Conservators and Conservators of Forests

in their respective provinces, and to make suggestions for filling the vacancies thus caused.

4. The Government of India have decided to adopt this suggestion. At least three months' notice should, however, be given, when possible, of the intention of any officer to proceed on leave in order to enable the Government of India to make arrangements for filling the vacancy created.

5. I am accordingly to say that the procedure referred to in paragraph 2 above may be adopted in future. Article 67 of the Forest Department Code will be amended in due course.

AFFORESTATION IN SCOTLAND.

The Inverliever estate has been purchased by Government for the purpose of demonstrating the proper methods of planting and growing timber in Scotland on the commercial lines which have proved so profitable abroad. The estate extends over some 12,500 acres, and has a frontage of about nine miles to Loch Awe, and an average depth of about two and a half miles. The loch stands 140 ft. above sea level, and the land rises from the loch in slopes and flats to about 1,400 ft. The aspect is S.S.W. and W. The soil has been generally pronounced suitable for planting by forestry experts, one of whom has had a wide experience in profitable planting in the Highlands. And they express their opinion that fine timber can be grown, which, if properly managed, will undoubtedly prove a commercial success. Patches of deep fibrous peat, thin land on rock, and also some high-lying ground about 1,000 ft. are to be found on the estate, which may not be suitable for growing the best timber; but perhaps two-thirds of the area of the estate, and under

an elevation of 1,000 ft., are eminently suited for planting. Plantations at present standing on the estates how a satisfactory growth of hardwoods as well as conifers.

Nurseries will no doubt be established on the estate, so that well-grown seedlings will be raised on the spot at a moderate cost, and without the risk of root exposure or frost. The cost of planting will, of course, vary according to the locality and class of trees to be planted, and the outlay on fencing and protection against game, squirrels, deer, and rabbits should be small. Perhaps an average of £4 10*s.* per acre will prove to be not far from the mark for the cost of planting. In the Highlands the growth of timber is exceptionally good, more especially on the lower slopes of the valleys where soil has accumulated, or in narrow sheltered valleys Large forests of conifers exist which show what can be done in the way of growing timber, though they may for want of access to railways and other causes not always find a very paying market at present. It is quite possible that the estimated available area of suitable land for planting in this country may be exaggerated. In my own experience timber showing size and quality cannot be grown at any great altitude above the sea—say 1,000 ft. at the very outside. Again, many soils are quite unsuited for planting though it seems to me that suitable shelter is of far greater importance than the quality of the soil. All the same, it is undoubted that an immense amount of land, and more especially in the Highlands, is suitable for planting, where land is cheap and rents range from 1*s.* to 3*s.* per acre. Even in the poorer or higher lands small timber might be grown to pay if markets were established and prices rose in consequence.

The advantages to be gained by the Government's action in purchasing the estate of Inverliever are immense. The fact that the Government has taken the matter up in earnest means business, and must appeal to many. An object lesson in treatment will be given which will be watched with interest all over the country. The lesson will be widely spread and learnt by many, who will be tempted to plant on their own account and on similar lines, and as the old fashions and ideas, doubts and fears, based on the experience

of a mistaken and obsolete system are swept away, other planters will follow. Then when good timber is being grown, and in quantity, the lost markets will be re-created and facilities for transport will be improved. Saw-mills, pulp mills, creosoting plant will be established to manufacture on the spot and make the most of not only the best-grown timber but the worst. Existing forests of timber well or badly grown may find a market at last. That the Government should now have joined forces with the best foresters and experts of our day holds out a bright prospect for the advance of afforestation in Scotland on commercial and profitable lines.—(*W. M. S. in the Field.*)

AFFORESTATION IN IRELAND.

The Committee on Afforestation in Ireland, appointed a year ago, have completed their report. Their most important recommendation is that County Councils should be empowered to acquire areas suitable for tree planting and cultivation, so that Ireland may again enjoy the vast woodlands she formerly possessed. Already a beginning has been made in this direction by the Department of Agriculture, who, under the powers of the Wyndham Act, have procured large spaces for afforestation purposes. It is suggested that the Commissioners of Woods and Forests should give some assistance in return for the £30,000 which they draw from Irish sources.—(*Timber Trades Journal.*)

EXPENDITURE ON AFFORESTATION.

In the House of Commons on Tuesday Mr. J. A. Pease stated, in reply to Mr. Wm. Redmond, that the amount spent by the Commissioners of Woods during the last ten years in England and Wales on afforestation, by which was meant the planting of new areas not previously under timber, as distinguished from replanting old woods, was about £5,000. The cost of land in England and Wales bought during the same period for afforestation was about £1,200. There has been no expenditure on planting new areas in Scotland and Ireland, but £25,000 has recently been spent

buying land in Scotland for afforestation. The land was now utilised as a sheep walk, from which a considerable revenue was received, and it was intended to carry out the planting of it gradually year by year.—(*The Field.*)

PREVENTION OF MOSQUITO BITES.

In a publication recently issued by the Government of India the author recommends—in cases where nets cannot be used—citronella oil as a preventive against mosquito bites. The oil, it is stated, can be bought pure from chemists (in India), and a few drops poured on the palm of the hand and then rubbed on the face, neck, and feet have proved thoroughly effective in the author's own case. The oil has a pleasant, non-wearying smell, which completely disappears the next day. In districts where lemon-grass, the source of the oil, grows, a bunch laid on the pillow and another near the feet will be found as effectual as the oil itself.—(*The Field.*)

RUBBER FROM A TUBER.

Rubber or caoutchouc is obtained from a variety of trees and shrubs, but it has not hitherto been known as the product of a turnip-like root or tuber. An American paper last year, however, contained an article on a biennial plant with a fleshy, turnip-like rootstock which flourished in the sandy, treeless plateaux near Benguela, in Portuguese West Africa, and which was the source of large quantities of rubber. It is known by the natives as *ekanda bitinga* or *marianga* and is a stemless biennial plant with a fleshy, tuberous root, in form resembling a flattened sphere from 3 in. to 5 in. in diameter, the entire substance of which is permeated with lactiferous ducts. The plant has no distinct stem, but on the top of the tuber it produces a few small herbaceous leaves and a little cluster of purple flowers. Living examples of these tubers have lately been forwarded to the Imperial Institute from West Africa for a report on the quality and commercial value of the rubber they contain. We are informed that they contain an appreciable

quantity of latex, which coagulates readily under treatment, and that the yield of pure rubber is at the rate of ½ per cent. of the total weight of the tubers. The largest tubers weighed about 1lb. and these were only two years old. It has been stated by a Portuguese expert that this plant will yield at the rate of 180lb. of rubber per acre at the end of two years. We have seen samples of the tubers, and if all that is said of them is true, we think it not unlikely that this plant, when the conditions are favourable, will be capable of cultivation on the same lines as turnips are. The tuber rubber plant must not be confounded with the root rubber plants which grow in tropical Africa, and which are known to be various species of *Landolphia*, the rootstocks of which are large, and contain latex. Nor is it the potato rubber, a term which refers to the method of winding the rubber in balls as it was collected. Tuber rubber is something quite different from anything previously known, and if only the plant seeds freely and is amenable to ordinary cultural methods, it ought to prove a valuable discovery.—(*The Field.*)

VOLUME XXXIV NUMBER 6

INDIAN FORESTER

JUNE, 1908.

MARKING TREES FOR FELLING.

The marking which has to be done before fellings can be made is, we maintain, the most important work which the Forest Officer has ordinarily to carry out. By marking we mean of course the work of deciding which trees may or should be felled under the rules in force for the area being operated on. Not only does the present yield of timber and the resulting revenue depend on the way in which the markings are done, but, more important still, the future welfare of the forests is mainly dependent upon the same thing. An ignorant man may, by marking with a view to present revenue or requirements, injure a forest to such an extent that it will take years of careful conservation to make up the loss, or he may even damage the forest more or less permanently (*i.e.*, in areas much subject to frost). On the other hand, he may err by not removing trees which, having reached maturity, cannot maintain themselves in a sound condition during the period of the felling rotation, and thus the material which is available in the present is allowed to deteriorate and perhaps even to go to waste altogether. (We allude of course to trees against

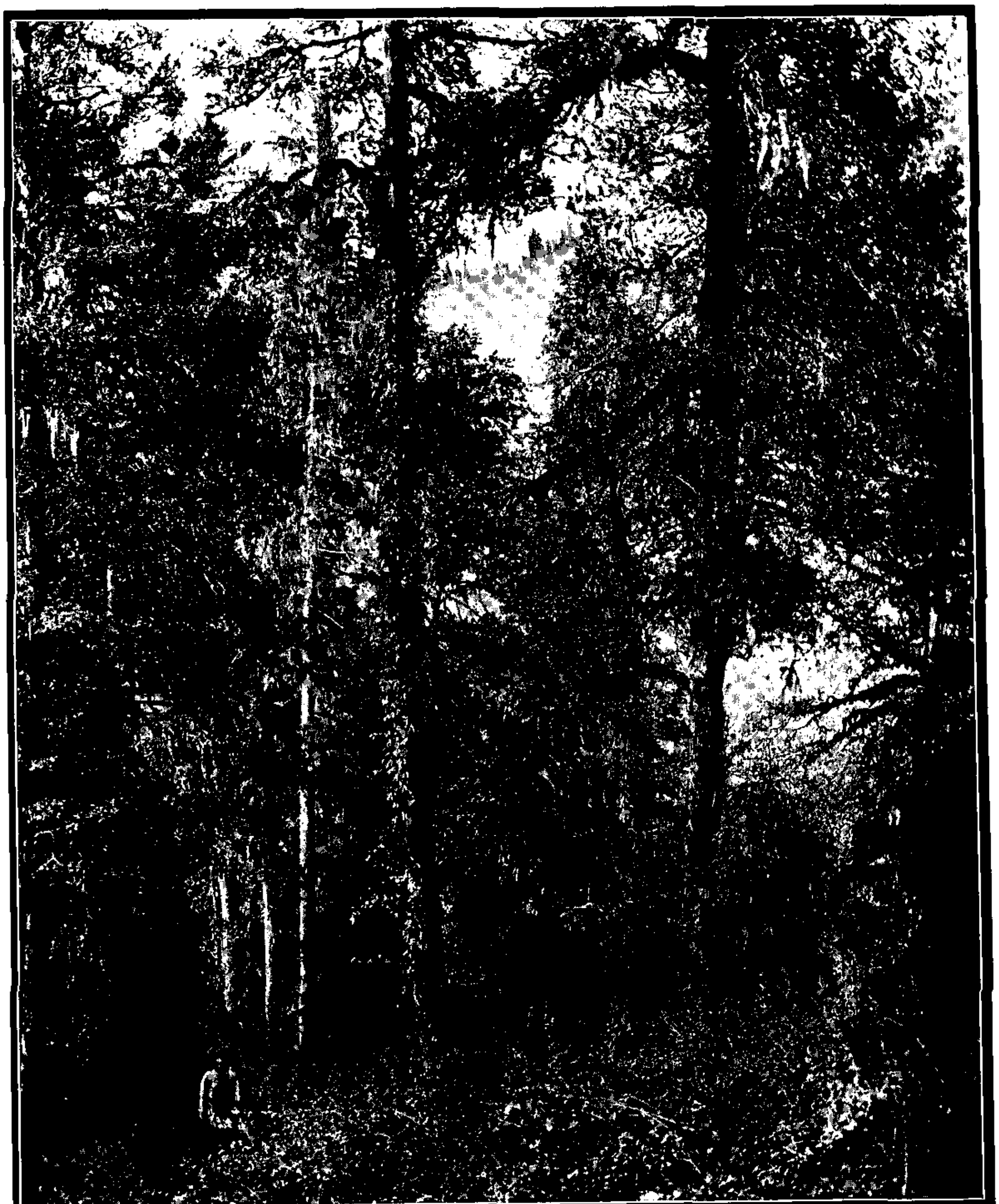


Photo.-Mechl. Dept., Thomason College, Roorkee. Photo by B. O. Coventry, taken June 1903.

Oak (Quercus semicarpifolia) forest invaded by Firs. Deoban, Jaunsar.

the removal of which there are no objections, from a sylvicultural point of view.) Further he may, by leaving badly grown, inferior, or mature trees which are suppressing good young growth, do an incalculable amount of harm. We mention these few instances to indicate the great importance of marking work; many others could be added, but we think the above is sufficient to justify our contention that marking is the most important work that a Forest Officer has ordinarily to carry out.

In former days when there were few trained men from Dehra Dun in the service, markings had to be done by untrained men, and often even by temporary employés. Needless to say with so large areas in their charges, Divisional Officers seldom had time to superintend the markings in detail. The work had to be done somehow, and all a Divisional Officer could do was to try and get the marking done on common-sense lines by untrained men taught by him personally for a few days now and then. In many cases quite good work was done and many of these untrained men learnt by practice to do very fair markings, but generally the reverse was the case, and it is seldom now that any area which was felled over formerly does not exhibit direct evidence of the inefficient manner in which the markings were carried out.

In our opinion marking is the work above all others in which the principles of scientific forestry can be fully and readily applied at once. A sound knowledge of sylviculture, great powers of observation and considerable judgment of all the physical conditions are required in order for the work to be done satisfactorily. Markings in fact provide a field for a trained man to make special use of his scientific knowledge, and if there are important markings to be done, his services for a few seasons cannot be utilised in a better way. We therefore maintain that all important markings should be carried out by trained men, and if this were insisted upon, it would do much towards ensuring the improvement of our forest crops.

From what we have said above, we by no means intend it to be understood that training necessarily makes a good marking officer, for no man can become efficient at the work without a

great deal of practice in addition to training. We believe that in Germany, all forest probationers have personally to carry out markings over a large area before they are appointed as Forest Officers. In this country, too, we think that all trained men should be given a turn at this important work. We would go further and insist upon every trained man qualifying himself after entering the service in marking work. It would not be necessary to have an examination, but it might be laid down that Divisional Forest Officers should give marking certificates to those who have done markings satisfactorily over a considerable area, say, 5,000 acres or so. In the lists of forest officials a distinguishing mark, say, an "M" might be placed against the names of those who have thus qualified.

In some provinces, where work is very intense or the markings extra important, officers are placed on special duty to do markings. The work is not popular and most officers prefer ordinary executive or controlling work as the case may be, and it often happens that the markings are entrusted to those officials who are found to be least capable in executive charge. When it is necessary for officers to be placed on special duty it would, we think, be a good arrangement to grant them an allowance, say, 20 per cent of their pay. In this way the work would become more popular and the better men would not endeavour to avoid marking work as is often the case at present.

If these suggestions were adopted, every man joining the service would have to undergo his apprenticeship in marking, and all officers, Imperial, Provincial and Executive, would acquire a sound knowledge of the work, which would be of utmost use to them throughout their service. Sylviculture is often not sufficiently studied; whereas marking work forces attention to the subject and brings prominently and repeatedly before the marking officer the problems awaiting solution, and the present want of information regarding the requirements of the various species. Once an officer's interest is directed to this subject, it is probable that it will go on increasing and result in advancing our knowledge in this all-important branch of forestry.

SCIENTIFIC PAPERS.

BRITISH FORESTRY.

II.

In the first paper of this series was described the start made by the Government in promoting the establishment of scientific forestry among British industries by establishing demonstration areas and making grants to educational bodies for purposes of instruction. The exhortation to "Go on!" which for the space of a generation was all the response that could be got out of our rulers by those who tried to rouse them to a sense of the necessity for action, has now been exchanged for the far more exhilarating "Come on!" A beginning has been made in the right direction; but before the Treasury can be persuaded to sanction further outlay and before private owners will be inclined to regard tree-planting as an investment instead of a luxury, they must be satisfied as to the reason why the existing woods of the United Kingdom, taken as a whole, are unremunerative; nay more—why the outlay on the Crown forests and on most privately owned woodlands largely exceeds the revenue. If there be a heavy deficit on the three million and odd acres now growing trees of sorts in the United Kingdom, what might it not amount to were that area of plantations doubled or trebled?

The objection most commonly raised against forestry enterprise in the United Kingdom is based upon unsuitability of climate, owing to the storms which sweep over these islands; yet it cannot be shown that atmospheric disturbance is more violent or frequent here than it is in the United States, Canada, Scandinavia, and other timber-producing countries. It is true that we have exposed seaboard, whereon profitable forestry is impossible, in greater proportion than these countries; but all our inland and mountainous regions, up to the 1,500 ft. level were once covered with dense primeval forest, which was cleared away to make room for pasture and agriculture. It is also true that British woodlands, such as

they are, suffer more from wind damage than Continental forests do, not because our gales are more frequent or furious than elsewhere, but chiefly for three reasons :—

(*1*) Our woods are almost invariably laid out in comparatively small masses, in blocks of a few acres, or in strips or clumps, planted for game, ornament, or shelter. In most countries it would be impossible to show a hundred acres of high forest in a single block; yet a thousand contiguous acres of forest will offer far better resistance to storm than a thousand acres distributed in patches and strips over an estate of 10,000 acres.

(2) The last sentence requires a proviso, which leads us to the second cause whereby wind damage is invited. The trees on the thousand contiguous acres must be grown in close canopy, offering an unbroken surface to the storm. This is precisely what British landowners have been taught during the last 250 years to avoid. "I conceive," wrote John Evelyn in his inimitable "Silva" (1664), "that it were better to plant trees at such distances as they may least incommode one another. For timber trees I would have none nearer than forty feet where they stand closest, especially of the spreading kind." Now Evelyn was writing for southern and midland England, where the natural tree growth was oak and elm; of the more northerly parts of the island he knew nothing except by report. In his day, and long after it, the timber most in request was oak, and that not in clean straight boles, such as good foresters aim at now, but crooked stuff for shipbuilding. It took 2,200 mature oaks of this description to build a single 74-gun ship, or the entire mature crop of 44 acres, reckoned at 50 trees per acre standing 30 feet. apart. This was the origin of the old-fashioned forester's rule of thumb, followed by most British landowners to this day, that the distance from tree to tree should be one-third of their height. The consequence has been ruinous and almost universal over-thinning, even where the chief crop is not oak; country gentlemen, who generally take much pride and interest in their woods, dreading nothing so much as that their trees should be drawn up by overcrowding. Trees treated in this manner, encouraged to form spreading heads and to grow

branches instead of boles, may be smashed or overturned by a storm which would be lifted harmlessly over a wood presenting a close canopy.

(3) Down to the close of the 19th century it was almost impossible to point to any woodland, other than coppice, in the United Kingdom managed according to a fixed working-plan and in regular rotation. Woods were felled when they were ripe, or not felled, according to the caprice or pecuniary requirements of the owner. Timber for estate purposes was cut quite without regard to the main crop; very often the squire himself, wholly without technical training in silviculture amused himself by marking the trees to be felled in his woods. The prevailing practice was hand-to-mouth, modified by local custom and individual caprice.

The reader may wonder why this statement is put in the preterite, not being aware of any revolution affecting British woodcraft in the last ten years. It is true that the aspect of our woodlands has not undergone any marked change; but it is also true that land-owners are awakening to a sense of lost opportunities, and that many of them have already taken advantage of the skilled instruction which has been provided, under which guidance working-plans have been drawn up and initiated on several large estates. This step, however, has brought us face to face with a difficulty which, in many cases, can only be overcome by co-operation, between neighbouring proprietors. Woods must not be felled without regard to the effect of the clearance upon adjacent woods; for storms visit such indifference with disastrous effect. Turning to German forestry management as the most highly organised in Europe, one finds this contingency amply provided for. Not only are the annual fellings upon each estate, Crown or private, carefully planned so as to avoid exposing growing wood on the same estate to the dangerous wind-quarter, but the law compels every owner to regulate such fellings with due regard to their effect upon the forest of adjoining proprietors.

The causes then for the greater damage inflicted by storms upon British woodland than upon Continental forest may be summed up as faulty design in planting, mismanagement during

growth, and want of management at maturity. On the whole, the British climate must be regarded as exceptionally favourable to tree growth being temperate and humid—conditions which render necessary a certain modification in forest management as practised on the Continent, where the winter is colder and the summer hotter than with us.

Before considering these modifications, it must be shown that planters may proceed to regenerate their woodlands with a reasonable certainty of finding a profitable market for their produce. At present, despite the incessant and increasing demand for timber, the complaint is commonly heard from British landowners that they cannot dispose of fine timber even when it is offered. I saw not long since in the north of Ireland a felling of several acres of superb Scots pine, about 100 years old, for which the owner had been unable to get more than 3s. 6d. a ton. Now a ton of mature Scots contains from 28 to 30 cubic feet; so here was timber of the finest quality being given away at 1¼d. a foot, which in a fair market should have brought from 6d. to 8d. Transport was not the cause of such an unsatisfactory price, for there are a railway station and a seaport within two or three miles of this woodland, and an excellent road to both. The real reason is not far to seek. My friend had established no regular business connexion, without which no productive industry can be carried on at a profit. Purchasers must have steady sources of supply; they cannot suit their requirements to the convenience of producers, and the landowner who has 50 tons of timber to offer one year, 5,000 tons the next, and none in the third year, must not expect to obtain good terms except by a lucky chance. It is only from woodland managed on a fixed working-plan, planted, grown, and felled in regular rotation that a regular annual quantity of timber, uniform in quality, can be put upon the market; and until such a system prevails in the United Kingdom, timber merchants will deal with those countries where these conditions are fulfilled.

It was stated in the former article that the German Empire, whence we used to draw considerable supplies of coniferous timber, has now ceased to export it, requiring all she can grow for her

increased industrial wants. Owners of forest in that country, where woodcraft has been practised on sound economic principles longer and more extensively than anywhere else, have derived full advantage from the advance in prices.

The following table, taken from Weber's *Handbuch der Forstwissenschaft* (1903) shows the steady increase in the revenue derived from the principal State forests during 20 years. By far the most of the land under forest is either mountainous, and otherwise wholly unproductive, or of such poor, sandy soil as would hardly bear a rent of 1s. an acre.

State forest.	Extent in acres.	Average net income per acre per annum, in shillings.			
		1877—81.	1882—86.	1887—91.	1892—96.
Prussia	6,250,000	3·7	4·1	4·9	5·1
Bavaria	2,100,000	5·6	5·8	7·0	8·3
Wurtemberg	500,000	10·2	10·8	12·5	12·5
Baden	254,000	9·8	10·5	11·9	14·0
Saxony	374,000	14·2	17·6	18·5	17·1
Alsace-Lorraine ...	370,000	8·3	7·7	8·6	10·0

From this it appears that the average annual profit per acre from German State forests had risen to 11s. 12 years ago, thoroughly justifying the policy of the Government in buying up, as it continues to do, all the suitable land that can be had for planting. Between 1867 and 1892 the Prussian Forest Department bought 329,850 acres at a cost of about £1,125,000.

British Crown lands reckoned as forest are as follow :—New Forest, 64,834 acres; Dean Forest, 18,710 acres; Windsor Forest and Park, 15,175 acres; other woodlands, 16,574 acres; Inverliver (acquired in 1907), 13,000 acres; total, 128,279 acres. Any comparison between these lands and German State forests is vain, because they have never been submitted to right forest treatment. An attempt was made in 1851 to put the New Forest under systematic management. Parliament passed a Deer Removal Act and directed that 10,000 acres should be enclosed and planted, but the

cry was raised of "vandalism"; fussy people agitated against interference with the landscape; so Parliament passed another Act in 1877, putting a stop to planting when only 5,000 acres had been enclosed, and decreeing that only those plantations formed since the year 1700 should be treated as under rotation. So now, of this fine tract of 64,834 acres, only 17,670 acres are under growing woods, the remaining 47,164 acres being kept as a combination of common pasture, deer park, and picnicking ground. Meanwhile, the ancient forest must disappear bit by bit; for even oaks are not immortal, and regeneration by seedlings is impossible on land so closely grazed—all of which must have afforded the German Emperor some food for thought during his excursions in that neighbourhood last autumn.

It may be hoped that we are on the dawn of a more provident era, and that the State, having made a start by setting the Forest of Dean on a sound system, and having purchased land in Scotland and Ireland, will pursue the course which has been followed with such profitable results in Continental States. It is not good to rely too much on the State for the development of the natural resources of the land. In ordinary commercial enterprise private capital is freely forthcoming; but in forestry the State enjoys such manifest advantage over individuals that the only hope lies in the Government taking the lead. Besides having command of capital and the means of foregoing interest thereon during the period of unproductive growth, Government pays no death duties on property administered for the Crown. A quotation from the report of the Departmental Committee on Forestry of 1902 shows how inequitably the present system of assessing these duties tells upon the owners of poor land, such as may be most profitably devoted to planting:—

Three systems of levying the estate duty on woodlands have already been tried since the introduction of the Finance Act, 1894, and that now in force is peculiarly unfair to the poorer districts. The ordinary rate of duty on agricultural estates rests on a *maximum* basis of 25 times the annual value of the land, the consequence being that in the richer districts, where land is valued up

to this amount, the [growing] timber itself bears no duty. In the poorer districts of Britain, however, and in Ireland, where under the Finance Act estates are valued down to 16 years' purchase, the death duty can, where there is a crop of timber to be valued, be levied upon the latter until the *maximum* is reached ; the *maximum* of 25 years' purchase thereby becoming, in those cases where an estate is sufficiently wooded, the *minimum* basis. It is, therefore, conceivable that duty calculated on nine years' purchase of an estate could be levied on its timber, which, were the estate more agriculturally prosperous, would be totally exempt. An estate in the comparatively rich land of Devonshire, for example, might escape a death duty upon timber which one in Argyllshire might have to bear to the extent of a fourth of the whole duty raised. Moreover, the pressure of such a death duty on timber must both act as a bar to afforestation in districts most needing it, and compel the realisation of immature timber, thus preventing the practice of sound forestry.

It requires but moderate acquaintance with land management and the financial position of landed proprietors in general to realise that private enterprise in planting on any considerable scale is out of the question under existing conditions. Very few are the land-owners who, even if they possess unemployed capital, can afford to lock it up during the non-productive period of tree growth and to pay tithe, rates, and taxes upon land from which, perhaps, no return can be expected during the lifetime of the planter. If Parliament ever comes to recognise the national importance of a steady supply of home-grown timber, it will have to follow the example of certain foreign Legislatures in lightening the burdens upon young woodland during the years in which it yields nothing, and in encouraging planters by supplying them with seeds and seedlings from State nurseries.

Meanwhile, what woodland owners have to consider is the best means of restoring to a productive state existing woods which have been deteriorated by neglect or drastic over-thinning. Alternative treatments will be discussed in a subsequent article.—(*The Times.*)

ORIGINAL ARTICLES.

ALTERNATION (ROTATION) OF FOREST CROPS.

During my experience in the forests, chiefly on the N.-W. Himalayas, several cases have come to my notice, where a forest has failed to reproduce itself from seed, even when precautions have been taken to ensure its success ; and in some cases when planting or sowing of the same species has been resorted to, the result has still been marked by failure. At first I used to attribute such failures to faulty treatment, or carelessness in carrying out cultural operations ; but, as the result of more extended observations, it appeared that this explanation could not account for all such cases but that the failure, in some cases at least, was due to an uncongenial soil.

At first sight this explanation appears contradictory, because from the fact that a particular species is already present on the ground, one would naturally conclude that the soil must be congenial for this species ; but this assumes that the soil is a constant factor, and does not take into account the fact that the soil may be a continually varying factor.

A little consideration will, I think, show that it is quite possible to have a particular species present, while at the same time the soil is incapable of producing another crop of the same species. If one considers the effect produced on the soil by the accumulation of debris from fallen wood and leaves, and the varying degrees of heat, light, moisture, and aëration to which the soil is subject at different stages of the forest's growth, it requires little imagination to realise that the soil must undergo steady and continual change under the influence of the forest vegetation itself. This change would be chiefly confined to the surface soil, upon which the forest is dependant for natural reproduction. The older trees already on the ground with their well-developed root-systems would not be affected to the same extent as young seedlings, and

may continue to exist for many years, although signs of deterioration may be recognised by the prevalence of fungus attack and a tendency to become stag-headed. There does not therefore appear to be anything extraordinary in the assumption that a forest of a particular species may be present on the ground, while at the same time the soil is in such a condition that it is unable to produce another generation of the same species.

If then the soil is undergoing continual change, and each species requires certain conditions of soil for its growth, it follows as a matter of course that the time must arrive in the life history of the forest, when the soil will have become so changed from its condition when the species first came on to the ground as to be unsuitable for this species, which condition will be marked by the absence of natural reproduction and the gradual dying off of the older trees.

As regards herbaceous plants, the case is somewhat different, for owing to their short span of life change in the soil is accompanied at once by a change in the species, and consequently the nature of the herbaceous plants growing on a soil, is a good indicator of the condition of the surface soil. What the actual changes are which take place in the soil under the influence of the vegetation growing on it, only careful investigation can determine, but they may be concerned with either its chemical, physical or biological qualities.

It has also been noticed, that, generally speaking, when a forest of a particular species fails to reproduce itself, some other species is intruding as an "advance growth." An explanation which at first sight commonly appears to explain this state of affairs, is to regard the former as a light demanding species and the latter as a shade-bearer; but such an explanation does not always hold good, because it will often be noticed that the same species which fails to reproduce itself under its own shade, will be found growing as "advance growth" under the shade of some other species, often of denser shade than that of its own species. For instance in the case the Blue Pine, it has been observed that there is often an absence of natural regeneration under its own cover, whereas an "advance

growth" of Deodar is present. It will not do to explain this by saying that the former is a light demander, and the latter a shade-bearer: for although Deodar will exist under considerable shade it only grows satisfactorily with a clear space over head, while, on the other hand, the Blue Pine is often found growing under the dense shade given by the evergreen oaks and piercing their crowns as if they offered little obstruction.

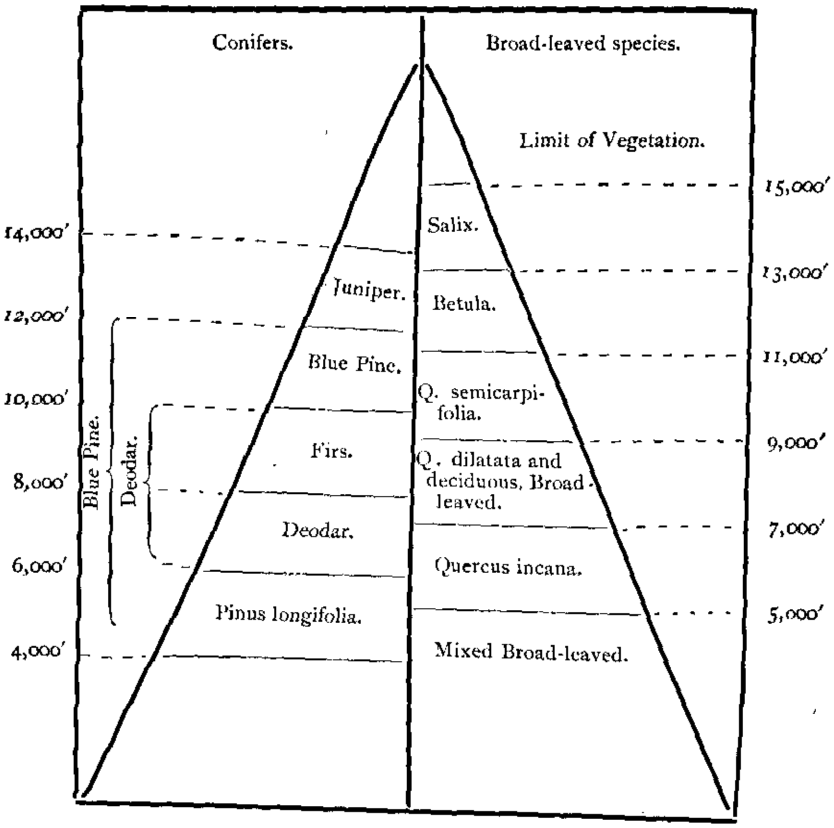
The failure of natural reproduction of Blue Pine under its own cover appears to be due to the soil for some reason or other having become uncongenial while at the same time certain qualities appear to have been imparted to the soil rendering it congenial to another species, Deodar, which appears as an "advance growth." At a later stage in its growth such a forest would present the appearance of a mixed forest, and at first sight might be regarded as a case of a struggle for existence between the two species, whereas it is not really a true case of a struggle for existence as the fate of the Blue Pine was decided before the Deodar came on to the ground. It is important to distinguish between a mixed forest of this type and one which is a true case of a struggle for existence. The result of the above observations seems to lead to the conclusion that a particular species comes on to the ground when the soil is favourable, and goes through a cycle of growth (it may be one or many generations), gradually disappearing as the soil becomes uncongenial, to be replaced by some other species, thus bringing about an "alternation of forest crops."

The Changa Manga plantation in the Punjab affords an example of a case where a comparatively rapid change in the soil appears to be taking place. The land now occupied by the plantation was originally "rakh" land (see photo. in the number of the "Indian Forester" for February 1907), and supported a growth of sparsely scattered shrubby trees, and during the monsoon months a crop of grass. During the remainder of the year the soil was bare of vegetation except for the few shrubby trees and had the appearance of a semi-desert, the soil being exposed to the full glare of the sun. Under the present conditions the soil receives an increased supply of water by irrigation, is protected from the sun by a dense forest

growth, and is accumulating vegetable debris from fallen leaves and wood. Under these new conditions it seems obvious that the soil must have changed considerably, and if so, one would expect to find a corresponding change in the vegetation. When the plantation was originally taken in hand several species such as Acacias, Mulberry, and Shisham (*Dalbergia sissoo*) were introduced, but the only one which succeeded was Shisham. This species forms natural forests on the new alluvial deposits left high and dry by the rivers, conditions corresponding more or less with the artificial conditions introduced, at the commencement, by the irrigation of the Punjab rakh land. The plantation is worked on the coppice with standard system with a 15-year rotation for the coppice, and although the stools still show considerable vigour in producing new coppice shoots, yet a considerable number of them die off every year, and a large number of the standards succumb to fungus attack, usually being blown over, owing to their rotten roots, evident signs of deterioration. At the same time another species, the Mulberry, has invaded the plantation as an intruder, growing with great vigour, so much so that a large proportion of the plantation has become converted into Mulberry forest, and there is not the slightest doubt that, if left to themselves, the whole plantation would soon become converted into one of Mulberry.

Although with artificial assistance it may be possible to maintain a crop of Shisham for some time, yet it seems inevitable that the time will arrive before very long when the soil will no longer support Shisham and this species will entirely disappear. It should be noticed that the Mulberry which now grows most vigorously failed to establish itself, when it was originally introduced at the time of the formation of the plantation. The above example seems to lead to the conclusion that under the influence of the forest vegetation itself, a change takes place in the soil which results in a change in the species, or, in other words, that an alternation of forest crops takes place.

With regard to the forests of the N.-W. Himalayas, the diagram on the next page shows the distribution of the chief species according to elevation.



The interesting points to note with regard to this diagram are—

(1) The alternation of a belt of coniferous forest with one of broad-leaved forest, which becomes more apparent if the different species are arranged in one series, and are considered as being represented at the centre of each belt, thus :—

Pinus longifolia	...	5,000′
Quercus incana	...	6,000′
Deodar	...	7,000′
Quercus dilatata	...	8,000′
Firs	...	9,000′
Quercus semicarpifolia		10,000′
Blue Pine	...	11,000′

(2) The preponderance of oaks of different species amongst the broad-leaved species.

(3) The remarkable adaptability of the Blue Pine, which is found extending from 5,000′ to 12,000′.

(4) The fact that at about 7,500′ which is the central zone between sea-level and the limit of vegetation, the greatest competition occurs.

Although there are a great many species of broad-leaved trees, yet the oaks form the most extensive forests. The conifers appear to show a decided liking for soil supporting oak forest, and generally speaking, wherever there is oak forest, conifers will be found intruding into it, and this is so general a feature that one cannot help thinking that there is some important connection between the two types.

PINUS LONGIFOLIA FORESTS OF THE MURREE HILLS.

The chief characteristic of these forests is that they form extensive tracts of pure forest to the exclusion of all other species except on their upper and lower limits, in spite of the fact that the species is extremely light-demanding. This is probably due to the custom of firing the forests annually or periodically. The *Pinus longifolia* has a very thick bark, and after attaining a certain size is capable of withstanding ordinary fires. The best natural regeneration is generally where the seed falls direct on to bare soil or on to a soil with a light grass covering, conditions which result from periodical firing, whereby the soil is kept clear of an accumulation of Pine needles. It seems probable that if such areas were entirely protected against fires, that the accumulation of pine needles would bring about a change in the soil, which would eventually result in the failure of natural regeneration of the Pine and the appearance of other species. The periodical firing appears to maintain a more or less constant condition of soil, which enables the pine to continually reproduce itself on the same area. Along the lower limits of the forests broad-leaved species area found associated with the Pines, and along their upper limits the evergreen oak, *Quercus incana* extends into them.

QUERCUS INCANA FORESTS OF THE MURREE HILLS.

This oak forms fairly extensive forests on the Murree Hills. They are characterised by a general absence of natural regeneration both from seed and coppice, and even sowings in the felling areas and in blanks are generally very unsatisfactory. Although natural reproduction on the soil occupied by the old oak forests is unsatisfactory, yet it has been noticed that natural reproduction takes place along the lower limits of the forests where they adjoin the *Pinus longifolia* forests, so that the oak is gradually extending into the pine forests. This is particularly noticeable near Charihan. Another feature about these oak forests is that the Blue Pine is found intruding into them as advance growth, and this is particularly noticeable in the Burban and Goragali forests, but generally speaking wherever there is *Quercus incana* forest, the Blue Pine will be found intruding into it.

DEODAR FORESTS.

The deodar forests are found at elevations between 6,000 ft. and 10,000 ft., but chiefly at about 7,000 ft. to 8,000 ft. Various types of forest are met with, sometimes pure forest, and elsewhere mixed forest with Blue Pines, Firs or *Quercus dilatata*. The chief species with which the deodar is usually associated is the Blue Pine. On open grassy slopes, which had been kept bare by annual fires, but which have recently been protected from fires, it is a common feature to find the ground becoming rapidly covered with Blue Pine and deodar. Owing to the more rapid growth of the Blue Pine this species obtains the upper hand, resulting in a Blue Pine forest with sparsely scattered groups of deodar. The characteristic of the Blue Pine is to grow very rapidly and die off at a comparatively early age, and it is generally found that trees above about eight or nine feet in girth when felled are rotten inside. The result is that the Blue Pine soon thins out, and as a rule this species does not reproduce itself well under its own shade. The deodar, on the other hand, shows a particular liking for the soil on which Blue Pine is growing, and as the Blue Pine thins out, the deodar replaces it. There appears to be no doubt that deodar is usually

at its best when associated with Blue Pine, and so much so, that it is usual to speak of the Blue Pine as the nurse of the deodar, the general idea being that the deodar likes the light shade of the Blue Pine. As a matter of fact the deodar grows much better without any cover overhead, and the conclusion seems to be that the Blue Pine exerts some influence on the soil which is beneficial to the growth of deodar. Sowings of deodar are usually more successful on soil which has recently supported a growth of Blue Pine than elsewhere.

In the Dheon Kaniali forest in Kulu, there is a patch of fine old deodar forest in which fellings had been carried out some years ago. Natural regeneration of deodar however was a failure, but instead of deodar the ground has become stocked with Silver Fir. Fellings in this forest were repeated about two or three years ago, but any one seeing this area would have no hesitation in predicting the failure of deodar reproduction again, and its replacement by Silver Fir. There seems no doubt that in this case the soil has become uncongenial for the growth of deodar, but suitable for the growth of Silver Fir. This forest is at an elevation of 9,000 ft. to 10,000 ft. and on a cold aspect, so that probably the soil has become too cold and moist for deodar. In other localities usually at lower elevations where deodar reproduction has failed, it is common to find Blue Pine appearing as an advance growth.

QUERCUS DILATATA.

In the Murree Hills natural regeneration is generally very deficient, but Blue Pine appears as an intruder. In Bashahr and Kulu these oak forests generally adjoin villages and are much mutilated by lopping for fodder, and it will generally be noticed that conifers such as Blue Pine, Deodar and Firs are invading these areas. In the Simla Hill Tracts I am informed that there are fine *Quercus dilatata* forests in which natural regeneration is all that could be desired.

FIR FORESTS.

These forests are chiefly found between elevations of 8,000 to 10,000 ft. There is a forest of Silver Fir at Murree at an elevation

of 7,000 ft. but the trees are mostly mature and are rapidly drying up and disappearing, natural regeneration is scanty, and the tendency seems to be for the ground to become covered by deciduous broad-leaved species. It would appear probable, that at the time when the Murree Station was formed, this forest was a flourishing one of Silver Fir, but that reckless cutting down of the trees for obtaining timber for building purposes resulted in exposing the soil so that it became changed from a damp soil such a Silver Fir likes, to a more or less dry and well äerated one, resulting in the deterioration of the Silver Fir. As the result of protection there appear to be indications of the soil returning to its former moist condition, which change is being accompanied by a gradual increase in the reproduction of Silver Fir. At Kanjatra in Jaunsar * there is an extensive Fir forest, consisting chiefly of Spruce with scattered Silver Fir trees, in which fellings have been repeatedly carried out under different methods, but have been followed by an absence of natural regeneration. Sowings and plantings of Spruce, Deodar and Silver Fir have been carried out in these areas, but success has only been obtained with plantings of Silver Fir. It appears that the soil has changed to a condition only congenial to the growth of Silver Fir and can no longer support the growth of Spruce. In the Nogli-Machodagad in the Bashahr Division it was noticed that there was a tendency for broad-leaved deciduous species to replace Silver Fir in forests where reproduction of the latter species was absent.

QUERCUS SEMICARPIFOLIA FORESTS.

Forests of this species are found at elevations between 9,000 and 11,000 feet and usually occupy the tops of ridges and are often surrounded by grass pasture lands. The tendency is for these forests to become invaded by conifers, and this is particularly noticeable near Deoban in Jaunsar, where Spruce and Silver Fir are found intruding into the *Quercus semicarpifolia* forests, as may be seen in Plate 14. At Daran in Bashahr the Blue Pine is present as advance growth in the *Quercus semicarpifolia* forests.

[In the Working Plan for the Jaunsar Forests, 1901, the necessity of an alternation of forest crops was discussed at some length.—Hon. Ed.]

BLUE PINE FORESTS

The Blue Pine is a remarkable species. It appears to grow almost anywhere between elevations of 5,000 and 12,000 feet, being found on soils of great diversity and on almost all aspects. Although one is most familiar with this species at elevations of 7,000 to 8,000 feet, where it comes into contact with the Deodar, yet it is at the high elevation of about 11,000, where this species occupies the ground with no opposition, and for this reason it has been shown in the diagram at this elevation. It has already been pointed out that at the lower elevations this species grows very rapidly, and dies at a comparatively early age; but whether this is the case or not at the higher elevations at which it grows I do not know, as unfortunately it did not occur to me to make observations on this point at the time when I had an opportunity of doing so. In the Naluk forest in Bashahr at about 9,000 feet which is one of Blue Pine, there is an absence of natural reproduction, and many of the standing trees are stag-headed and others quite dry, and the ground is strewn with fallen dry trees. Instead of reproduction of Blue Pine, the ground is becoming covered with regeneration of Silver Fir, and there is little doubt that the Blue Pine will be replaced by a forest of Silver Fir. This again indicates a change in the soils being followed by a change in the species. Further remarks with regard to Blue Pine have already been made in connection with the Deodar forests.

The above observations indicate that there is a tendency for each species to become replaced by another species, or in other words, that an alternation of forest crops takes place.

If the change involves a valuable species becoming replaced by an inferior one, the subject is one of importance, and the question naturally arises as to whether any steps can be taken to retard or prevent this change from taking place.

One of the fundamental principles taught in Forestry is the importance of maintaining an uninterrupted canopy for the improvement of the soil; but from the foregoing remarks, it would appear that under the forest canopy the soil undergoes steady and

continual change, which up to a certain point may be one of improvement for the particular species growing on the ground, but thereafter the so-called improvement is really deterioration in so far as this particular species is concerned and ultimately leads to its disappearance. In agriculture the fertility of the soil is maintained by resorting to artificial manuring or the "rotation of crops." The former, even if advantageous, would be impracticable in forestry, and the latter, although of no great disadvantage in agriculture where one is dealing with short-lived crops, is a more serious matter in Forestry when one is dealing with long-lived crops, unless valuable species can be found for the "rotations."

One can readily conceive that the changes which take place in the soil under the forest canopy, would be considerably influenced by such operations as grazing, removal of surface soil and periodical firing, and it seems probable that it will be necessary to rely on operations of this nature for maintaining the fertility of the soil for certain species. Many of our valuable forests have grown up under conditions where they have been subjected to annual or periodical firing which has resulted in the production of a certain type of forest, and it follows as a law of nature that if these conditions are changed, as, for example, by the cessation of fires, that there will be a change in the vegetation. Experience has shown that this is the case ; for example, in many of the Teak forests in Burma, which had been fired annually for many years, protection from fires has resulted in the gradual disappearance of the Teak, and its replacement by more inferior species.

Cases have also been noticed in the Deodar forests, where excellent reproduction takes place in forests open to grazing, whereas in other cases fencing against grazing has resulted in failure of reproduction, and in its stead a dense growth of rank weeds and shrubs has appeared. These examples illustrates the fact that it is impossible to lay down hard and fast rules with regard to sylvicultural matters. In some cases fires or grazing may be beneficial, whereas in other cases they may be harmful.

It seems probable that growing mixed forests rather than pure forests would result in maintaining the fertility of the soil

for a longer period than would otherwise be the case, for there appear to be indications that certain species act mutually towards one another by imparting certain beneficial qualities to the soil. Investigation may possibly show that many of our so-called inferior species, which are found associated with more valuable species and which are generally removed in cleanings and thinnings, exert some influence on the soils which is beneficial if not necessary for the growth of the valuable species, and whose removal will result in the disappearance of the valuable species.

From remarks made above, it follows that natural regeneration should be relied on as far as possible for the perpetuation of the species, and, where this fails, planting of the same species on the same area should be resorted to with caution. Natural seedlings only establish themselves where the soil is congenial, whereas by planting it is possible to force plants to grow in a more or less uncongenial soil, with the result that they produce only stunted worthless timber.

The success of natural regeneration however depends on the soil being in a congenial condition, and if observation shows that the tendency is for the soil to change under the forest canopy, resulting in a change in the species, it becomes important to investigate the nature of these changes which take place in the soil, and to ascertain what methods can be applied, to prevent such changes from taking place, or to restore an uncongenial soil to a congenial one for a particular species.

Since writing the above note, which was written some months ago and is the result of observations extending over several years, several articles have appeared in the " Indian Forester " which throw further light on the subject and tend to support the idea that an alternation of forests crops takes place. For instance in the September 1907 number of the " Indian Forester," Mr. A. W. Lushington has contributed an article in which he suggests that a period of rest and rotation of crops is wanted for Teak reproduction. Again, in the October and November 1907 numbers, there are articles under the titles " The Great Laboratory" and "Soil Fertility" respectively, which throw light on the nature of some of the

changes which take place in the soil under the influence of the vegetation growing on it. According to the latter article, it appears that plants throw off toxic matters into the soil, rendering it poisonous for that particular kind of crop; but not necessarily so for other kinds of crops. If this is so, it is not difficult to understand how an alternation of forest crops is brought about in nature.

In conclusion, there appears to be sufficient evidence to justify a more extended and closer investigation into the subject alluded to in this note, especially as such investigation would be likely to yield valuable information regarding natural regeneration, upon which success or failure in forestry is so largely dependant.

B. O. COVENTRY,
Deputy Conservator of Forests,
Punjab.

OXFORD:
March 1908.

FIRE-PROTECTION IN BURMA.

The Chief Conservator published in the December number of the "Indian Forester" some statistics showing the damage done by fire-protection, from which the value can be estimated. It was stated that, in the Tharrawaddy Division in which the observations were made, the annual revenue, from teak grown in forests which had been annually burnt over, amounted to 15 lakhs of rupees, and it was shown that under fire-protection natural regeneration disappears. Assuming that maturity is roughly 150 years and that interest may be calculated at 3 per cent, it would appear that the annual damage done amounts to Rs. 17,805, that is the present value of a sum of 15 lakhs, 150 years hence. This amounts to about Rs. 23 per square mile per annum. I have attempted to prepare a balance sheet showing the profit or loss on fire-protection per square mile, per annum. I calculate that at the utmost Rs. 10 should be placed to the credit of fire-protection on account of damage by fire prevented, and that against this should be placed Rs. 40 for cost of work, Rs. 23 for damage caused by fire-protection, and a large sum for part cost of establishment. Apart

from the latter item the adverse balance is Rs. 53. I am aware that many would dispute my figures, but, however, the calculations are made, can it be shown that the expense of fire-protection is justified? I am getting on in years but fire-protection was commenced in Burma before I was born, and there has been reasonable time to have collected some definite information regarding its beneficial effects, yet as years go on and as more experience is gained, the benefits become more and more doubtful and its injurious effect is now definitely established.

I have endeavoured to ascertain why fire-protection is being continued, and will attempt to show why the reasons given do not seem to me convincing. In the first place it is maintained that fire-protection improves the soil; that in Europe it has been proved that the natural and gradual decomposition of the dead leaves is of great value and that similar results may be expected in Burma. In extreme cases it is argued that fire impoverishes the soil and that even the ash, left when leaves are burnt, is dissipated by the wind or washed by the rain into the streams and thence to the sea. If fire-protection improves the soil the effect on the growth ought by this time to be perceptible. I understand that some experiments, carried out in Tharrawaddy for this purpose, tended to prove that growth was better in unprotected areas. Similar results were found in observing the growth of certain marked seedlings in this division. Probably in both cases other factors may have had an influence, and I consider the results by no means conclusive. I only mention these experiments to show that the only direct evidence which has come to my knowledge tends to prove that fire-protection does not improve the fertility of the soil.

In the absence of direct proof it is necessary to consider probabilities. There is little doubt that these forests have been burnt over annually for untold periods of time, and, as in spite of this, growth is most luxuriant—much more so than in any European forest where fire is unknown—I think the idea of "impoverishment of the soil" may be dismissed as a myth. As regards the improvement of the soil, the argument is based on

analogy. My knowledge of the subject is most inadequate, but I believe that in Europe, where leaves decompose gradually, humic acids are formed, which in turn cause the formation of various nitrogenous compounds which can be assimilated by plants, so that humus is principally of value as it enables plants to obtain nitrogen which they cannot absorb directly from the atmosphere. As, however, in fire-protected areas in Burma no humus is formed, it seems impossible to believe that "the chemical properties of humus are imported to the surface soil." Again in Europe it has been proved, I believe, that earthworms turn over, annually, per acre, about 10 tons of earth, thus fertilizing the soil in the same way that a farmer does with his plough, and it is probable that the argument that white-ants, beetles and other insects loosen the soil, refers to this method of fertilization. But in Burma earthworms are comparatively scarce. Digging seldom brings one to light, and it is probable that the soil, being hard as stone in the hot weather, is uncongenial to them. In some soils worm casts are fairly plentiful but I have not noticed a greater abundance in fire-protected areas. I have seen large quantities of dead leaves being devoured by termites and have endeavoured to discover what becomes of the material. It seems that every morsel consumed passes through the bodies of several termites by a process termed lactation, but I cannot discover definitely whether much is returned to the soil. Possibly some of the residue is concentrated in their mounds or nests, more probably, both in the case of termites and beetles, the leaves consumed are utilized to build up their structure and then that of insectivorous birds, and then that of other birds and beasts of prey, so that a long time elapses before any matter is returned to the soil.

When leaves are burnt only the ash remains, which however contains the essential salts. This is blown about by the wind and disappears, but I should think the probabilities are that it mingles with the finer particles of earth and falls into the numerous cracks and crevices, and that the first shower of rain, which is greedily soaked up by the parched soil, absorbs much of it and carries it into the soil, so that little is lost to the forest.

During the hot weather the soil contracts, and again during the rains it expands. The consequent separation of the particles of soil and aëration may possibly help to fertilize the soil, and if so the effect would be less appreciable in fire-protected areas where the dead leaves would necessarily act like a blanket.

In unprotected areas the leaves are burnt and disappear in March. In protected areas they disappear during the rains. The disappearance is so rapid in both cases that I should think the probabilities are that there is little difference in the fertility of the soil one way or the other, and am certainly not prepared as yet to accept the improvement of the soil in fire-protected areas as an "undoubted" fact.

The second argument is that the repeated burning back of young seedlings causes subsequent unsoundness. This argument is seldom put forward, and in any case has little force as it seems inevitable that fire-protection must be discontinued, at least temporarily, in order to obtain any seedlings at all. As trees in the middle age gradations are usually perfectly sound it must be assumed that the germs of disease lie dormant for many years, which seems improbable. Moreover, in saplings from unprotected areas which I have examined, I have found no trace of incipient decay. In forests where fire is almost unknown, as for instance the oak forests of Europe, the most fruitful causes of unsoundness are old age and suppression, and, seeing that most of the trees we are extracting are overmature, and that most of them have been suppressed at some time or another, it seems surprising that so many of the large logs one sees are perfectly solid.

The main argument on behalf of fire-protection is that the external visible wounds, which are undoutedly caused by fire, are thereby prevented. But on all sides one sees overmature trees, sickly and unhealthy trees, and dead trees—trees killed not by fire but as the Burmese express it by the "nats"—but unless the tree is hollow even these trees do not seem to be materially injured by fire, and in most cases the damage consists of little more than inverted V-shaped patches of dry timber at the base which do not seriously affect the value of the timber. As the damage is con-

spicuous it is natural that it should be exaggerated, and there seems also a tendency, when any tree is found marked by fire, to attribute all the damage to the action of fire, whereas it is possible that in many cases fire only obtained a hold because the tree was previously injured by suppression or of poor vitality owing to poor soil. It is, however, unnecessary to indulge in vague generalities as Mr. Rodger has supplied statistics from which the damage can be estimated. From this it seems impossible however the calculations are made and whatever allowances are made for doubtful factors, to show that the damage from fire is sufficient to justify the cost of protection.

These I believe comprise all the arguments for fire-protection. I will only mention one on the other side. It is a principle of universal application that, when two or more species are grown in a mixture, the struggle for existence should be so regulated that the more valuable species is favoured. Thus in growing oak and birch on the continent the matter is not left to nature, but the forest officer visits each area periodically (about once in 10 years), and by judiciously cutting back the birch, the inferior species, obtains a large proportion of oak in the final yield and thus increases its value. Teak in Burma is found in a mixture under analogous circumstances. There are, I believe, about 2,000 indigenous species of trees; various species of bamboo form a large proportion of the vegetation; and the grasses, herbs, and bushes which form the undergrowth, are serious competitors with young teak seedlings. These species are all more or less fire hardy since they exist in forests which are annually burnt over; their growth is most exuberant so that the struggle for existence is infinitely more keen than in any European forest. Yet so far from assisting teak against these species it has been proved that by fire-protection, the only work that has been carried out on a large scale, the proportion of teak has been reduced. There can be little doubt that by leaving teak entirely to nature there is great waste and destruction. I do not suppose that one seedling out of 100 ever reaches maturity. The destruction is naturally greatest in the youngest age classes but even thus, many trees unaided, attain marketable dimensions.

Their value is small as compared with that of trees which attain dimensions suitable for the European market, but the number of such prematurely killed, or "naturally dead" trees as they are euphonistically termed, is so great that they supply all the timber required for the Burma market. It is said that teak is a light demander and it is well known that its growth stagnates when suppressed, so there is great loss of increment. Most trees are bent, or forked, or deformed, in some way by suppression, so the depreciation in quality is great. To remedy this injury would be simple as it would only be necessary to cut back the inferior species where they are preventing the proper development of teak. Much could be done even with the present staff and expenditure, and the only obstacle appears to be that the energies of the staff are almost entirely concentrated on fire-protection.

When introducing fire-protection no distinction was made, but, now that the question of discontinuing it has arisen, the forests are divided arbitrarily into a number of different types. In my opinion they are fairly uniform in that there is almost invariably a dense undergrowth of bamboos, but a distinction is generally made between moist forests characterised by *kyathaungwa* (*Bambusa polymorpha*), and dry forests characterised by *myinwa* (*Dendrocalamus strictus*). As these forests are found in adjoining areas the difference would appear to be due rather to the quality and depth of the soil than to the rainfall, and in many cases it would be difficult to separate the two types of forest for the purpose of carrying out different treatment. The moist forests were the first to be protected from fire as they were the more valuable, and it is in these that the effects of fire-protection have been found so injurious, while in the dry forests the injury is not apparent, and as growth is less vigorous the injury by fire is greater. In many cases the soil is so poor that under no circumstances could timber of large dimensions be obtained, but where the soil is sufficiently good to produce fair-sized timber the damage by fire seems to be small, and it is improbable that on this account the expense would be justified. As yet fire-protection has had no very marked injurious effects, but at the same time no thorough or careful observations have been

made. Unless, however, there is reason to believe that teak is more susceptible to fire than the other species found, it would seem probable that the various species would gradually, and more slowly than in moist forests, readjust themselves, under the altered conditions, to the detriment of teak. It is only when seedlings have developed two or more large leaves that they are at all conspicuous, and in examining the annual rings in the taproot, I have been impressed by the fact that many seedlings which appear of recent origin, are really much older than they seem. Therefore, even if natural regeneration of teak had entirely ceased on the introduction of fire-protection, I doubt whether this would be as yet apparent. There is much work that would undoubtedly be remunerative which could be carried out in these forests, and to continue fire-protection, merely because it has not been proved to be injurious, seems to me a weak argument.

The suggestion has been made that an endeavour should be made to realise the beneficial effects, and at the same time to counteract the injurious effects of fire-protection by replacing the loss by artificial regeneration. The proposal may be summed up in the phrase now frequently heard, "first obtain your regeneration and then fire protect." The wording recalls the proverb "first catch your hare and then cook it," which is much to the point as hitherto we have not been successful in obtaining regeneration. If an area is to be protected for 100 years, during which time no natural regeneration can be expected, in order to obtain merely the same yield as at present, 100 times the amount of a normal annual natural regeneration must be concentrated into the space of one or two years, and even then it must be taken into consideration that fire-protection will have a prejudicial effect on the saplings, and that when further reproduction is required conditions may be unfavourable. It is probable that the cost would be great and that much labour would be required. On the other hand none of the trees in the final yield would be marked by fire, except owing to accidental fires which, however, owing to the accumulation of inflammable matter would be more harmful than the ordinary annual fires, but there is at present no satisfactory

proof that the value of the final yield would be much enhanced. "First exterminate your teak and then reintroduce it artificially" would describe the proposal with much more truth, as we are continuing fire-protection without having obtained our reproduction, and when we shall attempt to do so, I am convinced that it will be extremely difficult, if not impossible, to obtain adequate reproduction throughout the large blocks of forests from which we have excluded fire.

It is sometimes stated that the damage done by fire cannot be prevented by any other means than fire-protection. But on the principle that an unhealthy tree is more susceptible to fire than a vigorous one, I think much could be done to reduce the damage, by freeing trees from suppression and thus stimulating their growth. Saplings and young stems injured by fire could be cut back or pruned. Overmature trees are now being rapidly taken out, and subsequently when trees are girdled as they reach maturity, the percentage of trees marked by fire will be greatly reduced.

Although it is sometimes admitted as a matter of principle that some attempt should be made to justify an annual expenditure of nearly 3 lakhs of rupees and the concentration of a staff costing about 12 lakhs on this work, yet little serious attempt seems to have been made. In reading some of the literature on the subject, I have been impressed by the fact that the arguments urged on behalf of fire-protection are usually in the nature of vague speculation, frequently given as undoubted facts, as to what *will be* the result, but as fire-protection was commenced some 35 years ago and as some areas have been successfully protected for 20 and 30 years, if the benefits are at all commensurate with the expenditure they should be quite perceptible and it should be possible to state definitely what *has been* the result.

Although the work is carried out on account of its supposed *beneficial* results yet discussion as to its probable *injurious* effects is considered "academic," and to be deprecated. Simple inferences from well known facts are considered "theoretical," by which is implied in this connection something impracticable. It is only with the greatest reluctance that any conclusion adverse to

fire-protection is accepted. The effect on natural regeneration is a case in point. A slight knowledge of natural history would have shown that some such results, as now found, might have been expected by introducing abnormal conditions and by thereby upsetting the balance of Nature. The facts were first brought to notice by Mr. Slade in 1896, 11 years ago—but it is only recently, since statistics have been produced which there is no disputing, that the matter has been considered conclusively proved. Even such impartial critics as the late Mr. Slade and the honorary editor of the "Indian Forester" urged that we should exercise caution merely as regard the abolition of fire-protection.

To abolish fire-protection needs no proof. By discontinuing this expenditure it means that the forests are restored to their normal condition, in which it is known that without any help an annual revenue of 5, 10, 15 lakhs of rupees according to the division could be obtained. Accidental fires have occurred, usually at the end of the hot season, when fires are most injurious, so we know the worst that fire can do. Only one point has to be taken into consideration, the effect of fire on teak in plantations. We have by these means introduced teak under most unnatural conditions, and it is perhaps not fully known what the effect of fire would be. My recollection is that in the older plantations, in which the bamboo has re-asserted itself, fire does little harm. In the younger plantations, however, there is frequently a dense under-growth of grass which is most inflammable in the hot weather, but the stems are so closely crowded together that a great deal of labour in thinning would be saved if many of the stems were killed. The effect of fire in these plantations could however soon be definitely ascertained by means of experiments.

Caution is a most admirable virtue, but I would also apply it to the question of continuing to expend money on fire-protection. Fire-protection has been carried out on a large scale, but it is none the less an experiment, as we are thereby introducing altered conditions of which we are ignorant. Its possible benefits are a matter of surmise ; its injurious effects are a proved fact, and the logical inference is that it should be restricted to

small areas where it can do little harm and where it can be watched.

It is still maintained that fire-protection will eventually prove beneficial. It has been given a trial of 35 years, but if this is insufficient, I see no reason why it should not be continued for a further 50 years, or until visible results, which can be estimated and valued, are obtained. Whatever opinions each of us may hold, we are all interested in ascertaining what the effect will be, but the point on which opinions differ is the necessity of utilising all the finest teak forest in Burma to demonstrate this theory. Small sample plots would suit the purpose equally well, and better, as there would then be some likelihood that the experiment would be carefully watched.

It is no longer proposed to extend fire-protection to every teak forest in Burma so fast as fire lines can be made, and it has even been decided to discontinue it in selected areas, but the dislike to fire, even if it is based on sentiment and not on reason and fact, is deeply ingrained in all of us. The idea of letting fires sweep through areas where after great exertions and anxiety it has been successfully excluded for several years, is not a pleasant one, and it will probably be many years, especially in "dry" forests, before fire-protection is finally abolished. But now that it has been proved that fire-protection is not only not necessary but that it is harmful, so much so that it is resulting in the extermination of teak tentative measures and compromise seem inadequate.

The main point, to my mind, is not whether fire-protection is useful or not, but whether it is the *most* useful work that could be carried out. It seems to me indisputable that the fact that teak and other valuable species do not increase, is due not to mild leaf fires in the hot season when growth is dormant, but to the shade of the countless worthless species which suppress and suffocate them in the growing season. An experiment made in this division proved this very clearly. Some seedlings were marked in an area that had been protected for the longest time in this division. There was no doubt that they had originated before fire-protection was undertaken, but as several of them were under one foot in height,

it is obvious that they had not benefited to any great extent by six years of fire-protection. The area in which the seedlings were situated was burnt over, and simultaneously the cover was removed. As yet they have not suffered from the mild leaf fires, but have benefited enormously from the access of light having put on a height growth of six feet in three years. My main objection therefore to fire-protection is that it requires all our attention so that it is impossible to visit each area systematically—even once in 30 years, and far less in 10—in order to free the valuable species. When we are able to control the growth and to regulate the struggle for existence in whatever way we desire, then it will be time to deal with lesser evils and to attempt to control fire. At some future date we may even become independent of fire, or merely utilise it as our servant as we so fondly picture in our dreams, but for the present, with our huge areas and our small staff, it seems premature to attempt the task.

Our main object as forest officers is to improve the value of our forests. During all the years that these forests have been under our management we have done little but fire-protection, and have thereby reduced the proportion of our most valuable species, but I am convinced that when once fire-protection is abandoned throughout the teak forests in Burma we shall make great progress.

YAW DIVISION. H. C. WALKER.

RAILWAY FIRES.

The frequency with which forest fires are caused in India by sparks from trains, may render the following note on the Railway *Fires Act, which came into operation in England on 1st January,* 1908, of interest to readers of the " Indian Forester."

It may be well to review briefly the law on these points previous to the recent legislation.

By Section 86 of the Railway Clauses Act, 1845, power is given to a railway company "to use and employ locomotives, engines, or other moving power," and it has clearly been decided

in several important cases that this section of the Act operates to absolve a railway company from the liability, to which they would otherwise be subject, for a fire caused by sparks from an engine, provided no negligence can be shown.

It should also be noted that by Section 114 of the same Act engines must be constructed so as to consume their own smoke.

In order to secure this immunity from liability under the 86th section, the company must prove, as they usually can, that the engine is fitted with the best known appliances for preventing the emission of sparks, but this section does not protect a railway company, even when the engines are so fitted, if they are guilty of any negligence in other ways.

It is, however, unnecessary that any actual "spark arrester" should be fitted to the locomotive, provided that some efficient contrivance for preventing the escape of sparks, such as the "Adam's vortex blast" be employed.

One of the most important cases regarding railway fires is *Vaughan* v. *The Taff Vale Railway Company* (1858).

This was an action to recover damages for injuries to a wood belonging to the plaintiff through a fire caused by sparks from the defendant's engines.

The case was tried at the Glamorganshire Spring Assizes in 1858, before Baron Bramwell. The railway line of the defendant company passed on a bank by the side of a wood belonging to the plaintiff. It was shown that previously, in 1852 and 1853, the plaintiff had written to the company's local manager complaining of danger to the wood due to sparks from the locomotives, especially if the grass on the railway banks were allowed to grow long in the hot season. Since that time the company had ordered the grass to be cut every three months, and had adopted some contrivance in the form of wire shield to prevent the sparks flying out of the engine. On the occasion in question the grass on the banks, which had not been cut for three months, was extremely dry, as was the herbage and underwood in the plaintiff's wood. No sparks were actually seen to fall from the engine, but immediately after the train had passed, the plantiff's wood at a spot 50 yards from

the line was found to be on fire, with traces of fire between that spot and the bank where the grass was also burning, and considerable damage was done before it could be put out. There was contradictory evidence as to whether the sparks had first fallen on the grass on the bank, or in the wood. It was assumed as a fact that the precautions taken by the defendants were all that could be adopted to prevent the engines emitting sparks.

The jury found the defendant company guilty of negligence, and the verdict for the plantiff was upheld by the Court of Exchequer.

On appeal to the Exchequer Chamber this judgment was reversed, and a new trial was ordered on the ground stated by Cockburn, C.J., at p. 685 of the report: "It is admitted that the defendants used fire for the purpose of propelling locomotive engines, and no doubt they were bound to take proper precautions to prevent injury to persons through whose lands they passed, but the mere use of fire in such cases does not make them liable for injury resulting from such use without negligence on their part."

Without express statutory powers to make the use of locomotive engines lawful, the railway company would be in common law always be liable for all damage resulting from fires caused by the escape of sparks, even though no negligence were shown on their part.

It has sometimes been contended that railway companies have already paid compensation for the additional danger of fire at the time of the original acquisition of land, and that landowners whose land has been taken by the railway company, (but no others), can substantiate no further claim. This view, if correct, would tend to render the new Act imperative in the greater number of cases, and it seems probable that the damage for which compensation is paid generally refers to such a matter as severance rather than to the remote and unrecognised risk of fire. At the same time, it may be urged from the point of view of the railway companies that the well-known fact that crops, buildings, etc., within a distance of, usually, 100 yards from a railway, are not subject to the benefits of insurance policies without extra premium, would appear to show

that damage by fire to adjoining lands is damage which can be foreseen, and therefore might be supposed to be covered by the compensation paid at the time of acquisition.

The object of the new Act, which throws an additional liability on the railway companies, appears to be to ensure that any future damage, too remote and unthought of, at the time of purchase of the land, should be paid for.

The text of the Railway Fires Act, 1905, is as follows :—

Section 1, Sub-section 1—

When, after this Act comes into operation, damage is caused to agricultural land or to agricultural crops, as in this Act defined, by fire arising from sparks or cinders emitted from any locomotive engine used on a railway, the fact that the engine was used under statutory powers shall not affect liability in an action for such damage.

Section 1, Sub-section 2—

Where any such damage has been caused through the use of an engine by one company on a railway worked by another company either company shall be liable in such an action ; but, if the action is brought against the company working the railway, that company shall be entitled to be indemnified in respect of their liability by the company by whom the engine was used.

Section 1, Sub-section 3—

This section shall not apply in the case of any action for damage unless the claim for damage in the action does not exceed one hundred pounds.

Section 2, Sub-section 1—

A railway company may enter on any land and do all things reasonably necessary for the purpose of extinguishing or arresting the spread of any fire caused by sparks or cinders emitted from any locomotive engine.

Section 2, Sub-section 2—

A railway company may, for the purpose of preventing or diminishing the risk of fire in a plantation, wood, or orchard through sparks or cinders emitted from any locomotive engine, enter upon any part of the plantation, wood, or orchard, or on any

land adjoining thereto, and cut down and clear away any undergrowth, and take any other precautions reasonably necessary for the purpose; but they shall not, without the consent of the owner of the plantation, wood, or orchard, cut down or injure any trees, bushes or shrubs.

Section 2, Sub-section 3—

A railway company exercising powers under this section shall pay full compensation to any person injuriously affected by the exercise of those powers, including compensation in respect of loss of amenity, and any compensation so payable shall, in case of difference, be determined in England and Ireland by two Justices in manner provided by Section 24 of the Lands Clauses Consolidation Act, 1845, and in Scotland by the Sheriff in manner provided by Section 22 of the Lands Clauses Consolidation (Scotland) Act, 1845.

Section 3—

This Act shall not apply in the case of any action for damage by fire brought against any railway company unless notice of claim and particulars of damage, in writing, shall have been sent to the said railway company within seven days of the occurrence of the damage as regards the notice of claim, and within fourteen days as regards the particulars of damage.

Section 4.

The definitions as given in the Act are as follows:

In this Act—

The expression "agricultural land" includes arable and meadow land and ground used for pastoral purposes or for market or nursery gardens, and plantations and woods and orchards, and also includes any fences on such land, but does not include any moorland or buildings.

The expression "agricultural crops" includes any crops on agricultural land, whether growing or severed, which are not led or stacked.

The expression "railway" includes any light railway and any tramway worked by steam power.

This Act shall apply to agricultural land under the management of the Commissioners of Woods, and to agricultural crops thereon.

The definition of "agricultural land" excludes gardens attached to houses.

Section 5—

This Act shall come into operation on the first day of January one thousand nine hundred and eight, and may be cited as the Railway Fires Act, 1905.

The postponement of the date on which the Act came into operation to January 1st, 1908, seemed only a fair compromise, for it has given the railway companies additional time to try still further mechanical means for preventing the emission of sparks, and for the invention of a really efficient spark arrester.

Commenting generally on the Act, it seems that, as heretofore, farmers and landowners will have every inducement to take such precautions as would make the risk of fire as small as possible. This seems right and proper, but it may be urged that it would not be altogether equitable if the Act should have the effect of making the railway companies liable for fires, in cases where they had, by means of increased compensation at the time of the acquisition of the land, paid for prospective damage by fire.

H. JACKSON.

ABNORMAL TYPE OF BUTEA FRONDOSA.

(KHANKRA.)

SIR,—In the dry forests of the north and north-western portions of the Indore State, *Butea frondosa* (called locally *Khankra*) is the predominating species. There are continuous areas covered with *Khankra* either pure or mixed, sometimes with *Khijra* (*Acacia leucophlœa*) or dwarf and degraded *Sadad* (*Terminalia tomentosa*). The general condition of the growth of *Khankra* is poor, and it is only in private holdings or sacred groves that big or average sized trees are found. In one of such groves on the left bank of the River Kalisind, near Tarana Road station of the G. I. P. Railway, I saw during my recent tour a strange type of *Khankra*, a specimen of which is sent herewith thinking that it might be of interest. Unfortunately I could not get a complete specimen as I did not see the tree in flower, when its companions had their general share of blossom, and I was told by the people that the tree had never been known to blossom or fruit. This being an abnormal form of its kind, superstitious people have taken it as a miracle of God and set up stone boulders underneath it, calling these by the name of Bhairao, holding both the tree and the boulders in great reverence.

In the form and colour of its bark and wood and in the general mode of branching, there is nothing worthy of note. But the leaves depart from the general character of the species, in which they are always trifoliate. The specimen in question has only simple alternate leaves, with minute stipules on both sides of the petiole. It remains to be seen, whether these stipules can be reckoned as abnormal leaves, making no difference in the general morphology of the plant, or whether the tree is a fresh addition to the species of *Butea*.

A photograph of the specimen is reproduced in Plate 15.

CAMP KAPELI :
10*th March* 1908.

A. B. PUNDE,
Indore Forest Service.

[The specimen we have forwarded to the Imperial Forest Botanist.—HON. ED.]

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by B. V. C. Bodas.

Abnormal type of Palas (Butea frondosa) near Haytha, Indore State, C. I.
Collected by A. B. Punde.

CURRENT LITERATURE.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA. THE LOSS OF WATER FROM SOIL IN DRY WEATHER, BY Dr. J. W. LEATHER. (CHEMICAL SERIES, VOL. I, NO. 6.)—The subject of this memoir is one in which forest officers are deeply concerned, and we invite the attention of our readers to it. The data collected support two important deductions: (1) that during dry weather water moves upwards through the soil from a limited depth only, and (2) that the rate of loss follows the "compound interest law." The first, Dr. Leather says, is fully established, the second requires support by means of data obtained in a greater variety of soils.

BULLETIN ECONOMIQUE DE L'INDO-CHINE FOR NOVEMBER—DECEMBER 1907.—This number is chiefly interesting for the complete account (36 pages) of the history, organisation, development, objects, policy and prospects of the Forest Service in French Indo-China.

The chief aims of the service may be briefly stated as follows:—

(1) To preserve the minimum wooded area necessary from the point of view of climate and water-supply.

(2) To form forest reserves sufficient for the production of all kinds of wood necessary for local needs and for export.

(3) To improve and simplify the administration of the service.

Many useful hints may be gathered from this article and it is satisfactory to note that the policy of the future has been so definitely formulated.

CANADIAN FORESTRY JOURNAL FOR DECEMBER 1907.—Many important articles must be noticed this month. Mr. B. E. Fernow contributes a paper on the Education of Foresters, which is instructive reading. From it we gather that the University of Toronto has prescribed a course which will give the broadest professional forestry education, and secure students of the most promising character. The entrance requirements to the Faculty of Forestry have been made higher than those existing for any other

Faculty in the University, *viz.*, honour matriculation in English and Mathematics. For full details of the course of instruction we must refer those interested in the subject to the original article.

A paper by Mr. T. Southworth on Ontario's Progress towards Rational Forestry system indicates that the future in that province is hopeful. In five years 1901-05 the area of reserves increased from 125,000 acres to nearly 10½ million acres, and the latter area contains the major part of the pine timber yet unsold.

"Planting a Forest of Evergreens" by A. Knechtel, Inspector of Forest Reserves; "Forestry Conditions in the Arid Regions of the United States" by W. N. Hutt; "Conservative Lumbering in New Brunswick"; "What Practical Forestry Accomplished on a Spruce Forest in Maine," and "Forests and Floods" are all articles which will be found full of interest.

FORESTRY AND IRRIGATION FOR MARCH 1908.—This number of the Journal of the American Forestry Association carries on the campaign for the rational treatment of forests. A great many topics of current interest are dealt with in the editorial and pages devoted to notes. An account is given of the 27th Annual meeting of the American Forestry Association held at New Willard in Washington, D.C., on the 29th January 1908. The meeting was a record one, and totally eclipsed all previous ones. Summaries are given in this account of the various addresses made. It appears that there are now 126 million acres of national forest reserves in the United States, which indicates the enormous strides now being made towards reserving an adequate area for the needs of the country.

A paper appears on the Constitutionality of the Appalachian Bill which proposes to acquire by purchase and reserve a large area of the Appalachian forests which form the chief remaining supply of hardwoods. The Annual Address of the Hon. James Wilson, President of the American Forestry Association, is given in full. A perusal of this will show the progress that is being made and being aimed at in forestry. The importance of maintaining forests in the upper basins near the sources of rivers and their tributaries is emphasised in the speech.

The Report of the Directors of the American Forestry Association for 1906-07 is published. In this all the most interesting topics of the year regarding forests are touched upon.

Other articles are :—Improvement of Our Heritage by Gifford Pinchot ; The Propriety and Need of Federal Action by the Hon. Hoke Smith ; and Work in a National Forest, No. 6, Christmas in Sierra North, by C. H. Shinn.

EXTRACTS FROM OFFICIAL PAPERS.

DEFINES THE LINES OF WORK TO BE UNDERTAKEN IN FUTURE BY THE IMPERIAL FOREST ECONOMIST AND THE REPORTER ON ECONOMIC PRODUCTS.

Inspector-General of Forests' Circular No. 3/551-4, *dated the* 4*th March* 1908, *to all Conservators.*

I have the honour to invite a reference to this office circular No 9, dated the 28th October 1891, in which Conservators of Forests, etc., were asked, that until a decision had been arrived at on the proposal to make the Forest School at Dehra Dun the principal centre of enquiries in regards to Forest Economics, all collections of specimens of forest produce should be sent to the Reporter on Economic Products to the Government of India for transmission to the Imperial Institute, London, for analysis, etc. Owing to the recent establishment of an Imperial Forest Research Institute at Dehra Dun which is provided with a staff of experts on Forest Economics and Chemistry, certain modifications in the above procedure now appear necessary, and the orders conveyed in the circular referred to above may therefore be cancelled.

2. In order to utilize the staff and collections at Dehra to meet enquiries and indents regarding forest products and to apply expert knowledge in the collection of specimens, the lines of work to

be undertaken by the Imperial Forest Economist may be defined as follows :—

(1) All enquiries into questions of Forest Economics will in future be carried out by the Imperial Forest Economist who will publish the results. The Reporter on Economic Products will not be asked to send forest products on behalf of the Forest Department to the Imperial Institute for analysis or valuation.

(2) The Reporter on Economic Products has arranged to correspond with the Forest Department through the Imperial Forest Economist, and not directly with Forest officers. This arrangement will apply to all questions of forest economics and to requests for specimens.

(3) All indents for specimens of forest products required by the Reporter on Economic Products should be sent to the Imperial Forest Economist who will apportion them and receive and forward such information as the former may require.

3. It is impossible at once to make a hard and fast division between the respective lines of work to be undertaken by the Imperial Forest Economist and the Reporter on Economic Products, but these officers should keep each other informed when any new subject is to be taken up, and should decide by whom the investigation in the question should be conducted so that duplication of work may be avoided.

INDEX TO THE FIRST 30 VOLUMES OF THE "INDIAN FORESTER."

Government of India's Circular No. 9/122-1 F., dated 6th March 1908, to all Local Governments and Administrations.

I am directed to say that an Index to the first 30 volumes of the *Indian Forester* will be issued shortly and that copies will be supplied direct to the Chief Conservators and Conservators of Forests for their libraries and for those of Divisional Forest Officers. Spare copies of the Index will be available for Collectors and

other libraries where the back volumes of the *Indian Forester* are filed, and indents for copies, which should be forwarded to the Inspector-General of Forests, will be complied with as far as possible.

PAMPHLET AND LEAFLET SERIES OF INDIAN FOREST LITERATURE.

Inspector-General of Forests' Circular No. 5/151-1, *dated* 12*th March* 1908, *to all Conservators.*

In continuation of my Circular No. 3/200-4, dated the 13th February 1907, on the subject of the publication of Indian Forest Records and Indian Forest Memoirs, I have the honour to inform you that it has been considered desirable to supplement these publications by series of "Pamphlets" and "Leaflets."

2. The necessity for this step has made itself manifest owing to the diverse nature of the material connected with forest research which has to be dealt with, it having been found that papers of interest and importance are often received of a nature scarcely suitable for inclusion in either Memoirs or Records, but which if issued as "Pamphlets" or "Leaflets" would reach a wider circle of enquirers.

3. The "Pamphlet" series will contain summaries of the progress of observation or research into matter of economic or commercial utility and also tentative publications such as the "Glossary of Indian Forestry Terms," while the "Leaflet" series is designed to fulfil an equally pressing departmental requirement. It has, for instance, become important that efforts should be made to impart to those interested therein the results, stated in simple language, of practical experience having a direct influence on the improvement and protection of the forests, and to present such information in a popular form suitable to the use of all branches of the Department, and this will, speaking generally, be the scope of these publications.

4. The co-operation of all Forest Officers is invited in this new departure. Many officers who cannot spare the time to write

at length in the Records and Memoirs, will perhaps be able to communicate their special knowledge and experience on many interesting and important subjects through the medium of the Pamphlets and Leaflets, and by this means it is hoped that the knowledge of Indian Forestry will be less liable to be locked up in local official documents and be made available throughout the Indian Forest Department.

MISCELLANEA.

BALAGHAT FOREST SCHOOL, C. P.

In pursuance of the *policy of the Government of India* announced last year, to the effect that in future the training of the staff of the Lower Subordinate Forest Service should be effected in a Forest School to be established in each Province, instead of as heretofore at the Imperial Forest College, Dehra Dun, the station of Balaghat was chosen for the location of the Forest School for the Central Provinces; and thanks to the energy displayed by Mr. A. St. V. Beechey, Deputy Conservator of Forests, who was appointed to the Directorship of the School, quarters and a lecture room were most expeditiously erected for the students, and the School punctually opened on the 1st of April 1907. The period of the course, which aims at imparting sound practical instruction in Forestry and Surveying, is fixed, at present, at one year. On the 1st April 1908 the Board of Examiners, which consisted of Mr. Gradon, the Conservator of Forests, Northern Circle, Mr. Rogers, Conservator, Berar Circle, Mr. Hart, Conservator of the Southern Circle (in whose Circle the School lies and who is vested with its control), Mr. Beechey, the Director, assisted by Mr. Ghansyam Prashad Misra, Extra Assistant Conservator of Forests, the Instructor, commenced their sittings which were completed on the 5th April. On the 6th April, Mr. Gradon, the senior Conservator of Forests, presented the certificates and also prizes to the students, which consisted of hunting knives, water bottles, mathematical instrument boxes and various other presents suitable for the

use of Foresters, and they were gratefully appreciated by the recipients. Of the students who underwent tuition, 10 passed by the Higher Standard and 10 by the Lower Standard.

The number of students to be trained in 1908-09 has been fixed at 30, or 10 more than in the previous year, and is the maximum number that can at present be accommodated. Among them are 4 students from the C. P. Feudatory States and Zamindaris, which fact indicates that the owners of private forests are awakening to the advantages which arise from the systematic and scientific treatment of forests. In support of this I may state that this year 30 applications for admission to the School were received from members of the general public and owners of private forests, and also six applications from the Central Indian States, all of which had to be refused owing to want of quarters and accommodation in the lecture room. This appreciation has come nowise early. Further, considering that the Government Forests of the C. P. extend over 22,000 square miles or from nearly one-fifth of the total area of the C. P. and Berar, and that about half that area can safely be reckoned to be under Malguzari and Ryotwari Forests, leaving out of account the large area under the Feudatory States and Zamindaris, the future of the Balaghat Forest School is of greater promise that can be very well guaged at the present time, and on the degree of success attained by the School in the early years of its existence will largely depend the realisation of high expectations. The benefits of Forestry to the country in their economic, physical and administrative aspects, were admirably outlined by the Hon'ble Mr. Miller in the recent debate on the Imperial Budget at Calcutta, and were doubtless taken seriously to heart by the more enlightened owners of Forest Estates throughout India. Consequently in the near future a greater general importance can be expected to be attached to Forestry, and thus there is every reason to believe that the number of students that will be sent for training from private sources to Balaghat will considerably increase, and that the School will develop much importance. It is even possible that the School started with modest aims may expand into a large provincial

College, where the future Rangers or higher subordinate class will receive their scientific education. There is no gainsaying that in such a College the training of the upper class subordinates would eventually be cheaper for the Administration while the practical training would be confined to the study and treatment of such classes of forests, which of the diverse kinds to be met with in the continent of India, obtain in the C.P.

Balaghat has been happily chosen as the centre for the C. P. Provincial School, since the district of that name holds within it one of the best examples of the general type of teak forest found in the C.P., also sal forest, which is distributed over only a small portion of the C.P.: rich bamboo forests if they may be permitted to be put into a distinct class, and mixed forests of inferior species, which are worked to meet the growing demands for fuel and small timber.

On the evening of the 6th April sports were arranged for students, old and new. The programme and the names of the winners and prizes (which were contributed for by the Conservators and Director) are given below :—

1. 100 yards Flat Race.—Prizes Rs. 5, 3, 2. Brijlal, 5; Haribhaya, 3; Sheikh Wazir, 2.
2. Handicap Service Race.—Distance 120 yards. Prizes Rs. 5, 3, 2. Brijlal, 5; Sheikh Wazir, 3; Haribhaya, 2; Abdulrahman, 2
3. Sack Race.—Prizes Rs. 5, 3, 2.
   Daulat Ram, 5; Sitaram, 3; Sheikh Wazir, 2.
4. Half mile Race.—Prizes Rs. 8, 5, 2.
   Yeswari Bux, 8; Haribhaya, 5; Brijlal, 2.
5. Consolation Race.—100 yards. Prizes Rs. 5, 3, 2.
   Sadasheo, 5; Bharatgir, 3; Durgashanker, 2.
6. Tug-of-war.—Old students *versus* new students, 8 aside, Prize Rs. 10. Won by old students.

The Sack race, always grotesque, afforded much amusement and the "tug-of-war" was very evenly contested in the first of the three pulls. Mr. Beechey, the Director, was "At Home" to the station, who have to thank him for his liberal hospitality and a most enjoyable evening. Mrs. Gradon very kindly presented the

prizes to the winners in the reception tent which had been neatly arranged and set off with flowers and plants, and the evening wound up with the garlanding of the principal visitors by Mr. Ghansyam Prashad, the Instructor, and with cheers for Mrs. Gradon, the three presiding Conservators and the Director, who, to judge from the hearty cheers given for him, had quite won the hearts of the students. Mr. Beechey finally addressed the students in Hindustani and urged them to work hard and be a credit to the School, and always look back on the Institution as their "Alma Mater"; and to take away with them and foster the feeling of *esprit de corps*, which their training together, in the lecture room and the forest, and their association in the field, had engendered.—*(Nagpur and Berar Times.)*

INDIAN WOODS AND FORESTS.

The present Secretary of State for India could not have more fully or handsomely fulfilled his predecessor's promise—made on March 8th, 1905, through Lord Bath, the Under Secretary, in reply to a question put by Lord Lytton concerning the training at Oxford of selected probationers for the Imperial Forest Service of India—than by appointing the small committee, announced on February 24th, for the purpose of enquiring into, reporting upon and making recommendations concerning the selection of probationers, and the course of theoretical and practical instruction to be undergone during such period of probationary study as may be considered best. And Mr. Morley has shown his usual sound common-sense in choosing as members of this committee men whose nomination must carry the conviction that their investigations will be impartial and their decision wise and prudent, taking heed not only of matters which happen to affect India to-day, but also looking forward to future requirements both in India itself and in our many Colonies in tropical and sub-tropical parts. For in all of these, and even in Canada, Australia and other Colonies in the temperate zone, the measures this committee may think fit to suggest with special reference to the selection and

training of young British subjects for the Indian Forest Service will be of far-reaching effect. Indeed, they will probably apply immediately to nearly all our Crown Colonies, such as Ceylon, the Federated Malay States, Cape Colony, East Africa, Natal, Nigeria and the Gold Coast, and others, in each of which a Forest Department already forms a branch of the Government administration, and where, consequently, recruitment by properly trained young officers is a matter of importance. The chairman of Mr. Morley's committee is Mr. Munro Ferguson, M.P., the owner of extensive and well-managed conifer forests on his estates of Novar in Ross-shire and Raith in Fife. This gentleman was chairman of the Departmental Committee on British Forestry appointed by Mr. Hanbury, when President of the Board of Agriculture, in 1902. The other members consist of Sir John Edge of the India Council, formerly Chief Justice in the North-Western Provinces of India; Sir William Thisselton-Dyer, late Director at Kew; Mr. E. Stafford Howard, senior Commissioner of Woods and Forests; and Mr. S. Eardley-Wilmot, the present Inspector-General of Forests in India, who is being sent home specially to represent the interests of the Government of India, which is by no means satisfied with the present method of recruiting the Indian Forest Service. Originally, forest conservancy in India sprang up casually in different provinces during the first half of the nineteenth century, the lead in this respect being taken by Bombay and Madras. But soon after the assumption of Government by the Crown, in 1858, it was found desirable to organise and co-ordinate as far as possible these various local and provincial efforts. Thus in 1864 was formed the Forest Department as a subordinate branch of the Public Works Department of the Government of India. At first its officers were a sort of "scratch lot," with a large sprinkling of military men. But from 1866 onwards recruiting has been done by the selection of young British-born subjects, and training them at first for two and-a-half years, then subsequently for three years, in European forestry before they were appointed to service in India. From 1866 till 1906 selection was by means of a competitive examination held under the Civil Service Commissioners in

London, and from 1867 till 1875 the probationers thus selected were allotted partly to Germany and partly to France. From 1874 till 1885 they were sent only to the French National School of Forestry at Nancy in Lorraine, near the Vosges, and from 1885 till 1905 they were trained at the Cooper's Hill Indian Engineering College at Englefield Green in Surrey. Cooper's Hill had been opened in 1871 for training young men for the Public Works Department in India, and the training of the few telegraph officers needed was also soon undertaken there. But when public works had to be curtailed in India owing to the fall in the value of the rupee, and more especially after the large temporary reduction of establishment that took place in the strength of the department in 1879 and 1880, the number of recruits annually required sank so low as to entail a heavy loss on the working of the college. So, partly to enable it to pay its way, and partly for other reasons, from 1885 onwards the forest probationers were mainly educated at Cooper's Hill, their two years' theoretical course there being followed by extensive tours in France and Germany, and latterly by about a year's residence under a German head-forester in order to become acquainted with practical forestry on a large scale. On the abolition of Cooper's Hill, in July 1905, and without in any way consulting the wishes of the Government of India, which paid the piper and should therefore have had a right to call the tune, the Secretary of State transferred the two Professors of Forestry to Oxford. There the theoretical instruction previously given at Cooper's Hill has been continued from October 1905, the curriculum consisting of a two years' collegiate course in forestry and the cognate sciences, followed by one year's practical work in Germany. But as this arbitrary action and official preference really meant a grant of £1,200 a year to Oxford, being the amount of the salaries paid to the two professors, Cambridge naturally began to ask questions in Parliament; and the result of these questions was that in March 1905, a formal promise was given in the House of Lords that the matter would be reconsidered in three years' time; that is to say, in March 1908. So Mr. Morley has redeemed Mr. Brodrick's promise by appointing this committee. In order to be able to

satisfy itself fully, and to be in a position to make sound and well-considered recommendations for the future recruiting for the Indian Forest Service, the committee will no doubt have to examine the existing conditions of service and see if these are such as may be reasonably expected to attract exactly the class of young men that the Government of India may desire to have as executive and administrative officers in charge of woodland estates representing an enormous capital still capable of vast financial improvement under sound and prudent management. As a recent organisation in 1906 improved the salaries, it is in the poor pensions sanctioned that the weak spot will be found, for forest officers have during these last twenty years been shabbily treated on this point in comparison with public works and telegraph officers. It was for this reason that the system of selection by open competition, obtaining since 1866, broke down completely in 1906, when the nineteen appointments offered went a-begging and nominations were given " by selection" without any examination at all. This method of nomination in 1906 and 1907 has excited great discontent in India, while the arbitrary quasi-endowment of Oxford has called forth equal indignation in Britain. As the Universities of Edinburgh, Newcastle, Bangor and Cambridge provide forestry instruction and confer degrees or diplomas of forestry, and as forestry is also taught at Cirencester, Downton, Aspatria, Wye and other agricultural colleges, the Indian and all our Colonial Services might now quite easily be recruited by means of competitive examinations in forestry among students with certificates or diplomas from such institutions ; and the probationers thus selected can probably best be trained specially for their future duties by endowing one Chair of Indian Forestry at Oxford and another at Cambridge—where most of the Indian Civil Service probationers study—and by making this specialised course extend over one academic year (October till June), to be followed by an extensive tour on the Continent. This would suit Colonial as well as Indian requirements, for Colonial forestry must look far more to our Indian methods and experience than to any Continental model furnished by France or Germany.—(*J. Nisbet in Country Life.*)

FORESTS OF BRITISH COLUMBIA.

We are glad to learn that vigorous action has been taken to conserve the forests of British Columbia. By a recent ordinance all the available timber land had been made into reserves, estimated to amount to 150 million of acres. This is exclusive of large areas which have been leased, the system being that the lessee pays a nominal rent until he is ready to cut the timber, and afterwards a royalty upon what he removes. Some idea of the extent to which felling has been going on will be gleaned from the information that the income from leases was about $1,275,000 last year. It is no doubt the appearance of numbers of United States speculators in British Columbia that has caused the authorities to take so timely a step. The U. S. Government did not create national forest reserves upon an extensive scale until recently, and after very great damage had been done to the forests by the lumbermen, enormous fortunes having thus been made at the national expense. These destructive operations having been seriously restricted in the States, British Columbia was turned to as offering an equally promising field. Without judicious conservation it is certain that the forests there would disappear in a short time. The action taken will have the effect of checking waste and of increasing the Government control. Timber cutting in America is conducted on a scale which, when set down in figures, seems almost difficult to believe. The matter of the timber supply of the future is becoming a very serious problem. Almost all over the world the natural supply is disappearing very fast. Obviously, replenishment by planting will have to be extensively resorted to, and it is inevitable that eventually prices will be enormously increased. Timber production is a source of considerable prosperity over a great part of northern Europe, and we sympathise with those who maintain that the time has arrived when forestry should become a live industry in our own country.—*(The Field.)*

THE ARTIFICIAL RUBBER PROSPECT.

While a great deal has been printed in England and the British colonies during the past year on the subject of "artificial" or "synthetic" rubber, and the possibility of some such material competing with natural rubber, it does not appear that any real progress has been made in the new field. In other words, the rumours referred to have served only to scare some investors in rubber planting companies.

The sentiment of the British crude rubber trade, after a year of such rumour mongering, is well expressed in this paragraph from the review of the trade for 1907 issued by Lewis & Peat, London rubber brokers :—

"During the past year artificial rubber has been talked about a great deal, but so far nothing tangible has been forthcoming and we do not know anyone in the rubber trade of any importance or authority who believes in the likelihood of the production of a substitute for the real article, or has seen a sample of it, and at the lower range of prices for all kinds of rubber and the increasing supplies the danger now from the source is more remote than ever."
—*(Indian Rubber World.)*

VOLUME XXXIV NUMBER 7

INDIAN FORESTER

JULY, 1908.

THE ENQUIRY CONCERNING THE PHYSICAL EFFECTS OF FORESTS.

In the March number we alluded to the enquiry ordered by the Government of India on this subject. The matter however is an exceedingly difficult one to investigate, and we fear that there will be few accurate data immediately available. We have to remember that in such a problem there are a great number of causes at work and it is no easy matter to select one (*i.e.*, in this case forests) out of the many and to ascertain the effect of it alone.

In all countries in which scientific forestry has received the attention it deserves, there is a strong belief that forests do tend to increase rainfall. Up till recently, we must confess, many people failed to realize how it could be possible for forests of 100 or so feet in height to influence the precipitation from clouds several thousand feet above them. Of late, however, some new facts have been observed at high elevations above forests by balloonists, among whom, at the present day, it is an axiom that the temperature decreases when passing over extensive forest areas, so much so that the descent of the balloon, caused thereby, has to be

Photo-Mechl. Dept., Thomason College, Roorkee. Photo by Gulab Rai.

Tikri Sal Forests, Gonda Division, U. P. under Coppice with Standards.

Coupe I felled in 1888-89

checked by a considerable discharge of ballast. This effect is felt as high up as 4,000 to 5,000 feet above the forests. We must refer our readers again to Mr. Pearson's translation of M. Henry's article on "Forests and Rainfall" which we published in the February number. In this article fuller details of this hitherto improved fact are given.

Now it is obvious that if forests cause a decrease in temperature to such a considerable height, rain-bearing clouds passing over the land would, on meeting the cooler belt of air above the forest, probably often be induced to precipitate rain. This would not always be the case ; it would be a matter of the degree of temperature of the clouds and of the belt of air above the forests. Other things being equal, though, there would be a strong tendency in a given time for more rain to be precipitated over an extensive forest area than elsewhere.

Above, we have supposed that the cool air, given off by forests remains stationary above them, but this in practice would seldom be the case. The cool air given off by the forests would be carried on by whatever air currents were moving at the time, and this cool air would tend to decrease the general temperature of the air even above the surrounding parts of the country where no forests existed, and the general tendency would be, to render the condition of the atmosphere more favorable for inducing precipitation should rain-bearing clouds pass over. We can readily deduce from this, that in a country with a suitably distributed forest the general atmospheric conditions would be rendered more suitable for causing rainfall by the circulation of air cooled by the forests, than would be the case if there were no forests. It is this circulation of the cool air which makes observations so difficult and has deceived the many observers who maintain that forests have little influence upon rainfall. The enormous influence of forests on rainfall can be much more readily perceived, if we compare two separate countries, or sufficiently large tracts in one country, in which one has suitably distributed forests and the other no forests at all. We strongly maintain that forests have a much greater influence on rainfall than any observations, as yet available, tend to prove, and we base our argument on the

proved fact that extensive forests do reduce the temperature to such an extent that the effect is felt at 4,000 to 5,000 feet above them.

The beneficial results of forests on the retention and regulation of surface moisture is a generally accepted fact, but it will be hard to produce data to prove that this is the case. We believe indeed that in India accurate observations and data as to the physical effects of forests are almost altogether wanting. Yet it may be stated that the influence of forests on agriculture and on the general welfare of the country is as important, if not indeed more important, from the point of view of the general physical effects caused by them, as it is from the point of view of the supplies of forest produce derived from them. This being so, we must acknowledge that the subject has been greatly neglected in the past. We are not hopeful, as we have already stated, that any accurate data can be immediately elicited, though it is probable that many general statements may be recorded in the present enquiry. We therefore strongly advocate that a definite line of research in this most important subject be instituted, and regular experiments and observations be carried out for a long series of years. The present officers of the Imperial Research Institute have as much work as they can cope with in their own branches of investigation, while the work of Divisional Forest Officers is continually on the increase. To obtain accurate information in this matter, we suggest that a new post be added to the establishment of the Imperial Research Institute, *viz.*, that of Imperial Forest Physicist or Meteorologist.

SCIENTIFIC PAPERS.

THE RUBBER PLANT OF SOUTHERN EUROPE.

BY PROFESSOR MATTEI AND M. GUSTAVE VAN DEN KERCKHOVE.*

From the most remote antiquity a certain plant which is found scattered throughout the region of the Mediterranean, including a considerable part of southern Europe, has been noted for the viscid glue which it exudes. Dioscoride (III, 8); Theophrastus (VI, 4-9); and Pliny (XXI, 56; XXII, 21; XXVII, 3) all speak of it at some length, designating it by the name "Chamæles" [Chameleon], because of the different colours it is said to take on, according to the soils upon which it grows. In more recent times other savants have made abundant mention of it, such as Onorio Belli (en clusio Hist., 1601, 301); Fabio Colonna (Eiphr. I, 1616, 3); Prospero Alpino (Exot., 1627, 126); Paolo Boccone (Rech. Obs., 1674, 190); and Tourneforth (Coroll., 1703, 33).

This species was called by Linnæus (Species plantarum, 1753, 892) *Atractylis gummifera.* It was classed in the genus *Carthanus* by Lammark (Encyl. I, 1783, 639); transferred to the genus *Acarna* by Willdenow (Sp. pl., III, 1800, 1699); and to the genus *Cirselium* by Brotero (H. Lusit. I, 1804, 346); and finally it was placed in the genus *Carlina* by Lessing (Syn. Comp., 1832, 12). Cassini (Dict. 47, 1827, 509) classed it under the head of genus *Chamæleon.*

Without desiring to engage in any discussion of classification which would take us away from the practical object of this article, we will say that it seems to us that this plant ought to be classified in the genus *Atractylis*; it is therefore justifiable to continue to speak of it by the name given it by Linnæus.

* Professor Mattei is connected with the botanical garden at Palermo, Italy, and Monsieur van den Kerckhove, of Brussels, is widely known as an expert in rubber.—THE EDITOR, *India Rubber World.*

DESCRIPTION.

For its description we deem it proper to repeat that given by Bertoloni (Flor. It. IX, 1853, 62). It is very clear and perfectly accurate, as follows :—

The root is fusiform, fatty, full of a resinous gummy sap of an agreeable odour. Leaves, springing from the root, numerous, large, pale red, feathered or bi-pinnated. Branches, unequally serrated with strong thorns, long, hard, green, sometimes glossy, shining and crackling ; sometimes consolidated, with large, thorny pectinate stems. Trunk, either non-existent or very short, simple, covered with thick leaves like the others, the upper ones indented and serrated on the whole lower edge, thorny and pectinate. Head, very large, covered with bracts with thorny toothed leaves, the terminal thorn alternate, of average length. Calyx, hemispherical with scales lanceolate lined, extremities in tufts or masses terminating in thorns, the edge being without thorns, the upper ones not glossy and of a purple red. Corollas, purple, with a long, slender tube, divided on the edge into five parts with linear points and sharp hairs. Fruit, yellow, covered with hairs and with a very short stamen. Stamen, very long, white, shiny, with hairs fastened together at the base. Receptacle, thick, yielding drops of a resinous gum which coagulates on contact with the air ; of agreeable odour. The paleæ of the receptacle have undivided articulations, or are united and cut at the point.

GEOGRAPHICAL DISTRIBUTION.

The *Atractylis gummifera* is frequently found in continental Italy, in the Abruzzi, Maleda, Tavoliera, and even as far as the southern extremity of the Peninsula. It is found particularly in Gargano and Sila, as is mentioned by Tenore (H. Neap., II, 1820, 194). It is very common in Sicily ; Gussone (H. Lic., II, 1843 434) says that it is found everywhere; it is also common in Sardinia as mentioned by Morio (H. Sard., II, 1840, 436). In Corsica it was remarked by Grenier and Godron (H. France, II, 1850, 279), and at Malta by Grech Delicata (H. Melit., 1853, 20).

It is very common throughout the Peloponnesus and also grows in Asia Minor according to Boissier (H. Orient, III, 1875, 451); in Greece it is found, particularly in Epirus, Bæotia, Attica and Laconia, as is mentioned by Halaesy (H. Graec., II, 1902, 94); according to Heldreich (H. Cephal., 1887, 26) it is not rare in Cephalonia. In Crete it is found in abundance, as has been remarked by Tourneforth (Coroll., 1703, 33), and confirmed by Raulin (H. Cret., 1869, 483).

It is also found generally in southern Spain, according to the statements of Willkomme and Lange (H. Hisp., II, 1870, 131), and in Portugal, according to Colmeiro (Plant. Hisp. Lux., III, 1887, 287).

In regard to northern Africa, Desfontaines (H. Atl., II, 1800, 252) has declared it to be abundant in Morocco, Tunis, and Algeria, and as to the latter country he is corroborated by Battaudier and Trabut (H. Alg., 1888, 486); as to Tunis, Bonnet and Baratte (Cat. Tunis, 1846, 234) say it is common in the north and the centre, as well as in the land of the Kroumirs, but more rare in the south.

In continental Italy it lives in the chalk hills, while in Sicily it grows in remote dry fields, or in the sun, near roads; in Sardinia in fields near the sea. In the Peloponnesus it is said to grow in uncultivated fields and at the roadside; in Spain it is found in miry places, on the borders of fields and roads. In northern Africa we are assured it likes uncultivated places, open to the hot sun, particularly fields, brushwood beside the highways, and on the slope of hills.

We know it to be common in Sicily, particularly in open, sunny spots by the sea and even to a remarkable height in the mountains.

USES.

From remote times, the gum which exudes from this plant has been known. Fabio Colonna (Eph., I, 1613, 3) said on this subject: "Guardians of herds gather the gum produced in the corolla and between the thorny leaves of the calyx and call it wax of cardo,' for it becomes hard like wax and they use it as a paste or glue. It does not stick so quickly as birdlime and

stretches out in white filaments resembling milky sap, and hardens like wax; then it turns black."

Onorio Belli (en clusio Hist., 1601, 301) describes a curious practice existing at that time in Crete. "The children," said he, "gather the gum and chew it, then they press it in their finger and roll it into a ball which they squeeze in their hands so as to cause it to burst with a noise: they amuse themselves a great deal with this sport." This practice still exists in Sicily, as Mr. Teodosio De Stefani assures us, and it is curious to compare this method with that first employed by the Mexicans to extract rubber from the guayule plant. From this habit, prevalent among the Sicilians, of chewing the gum of the *Atractylis gummifera* a long time to free the rubber from the resins which it contains, its name masticogna is perhaps derived.

The rubber thus obtained being quite pure, they dissolve it in spirits of turpentine to make a sort of birdlime, by means of which they catch birds; this is the practice, not only in Sicily, but also in the whole region of the Mediterranean, as the authors above quoted point out.

ANALYSIS.

The idea that the *Atractylis gummifera* might contain rubber was suggested by information obtained from an article in the *Gazette Chimique Italienne* (Italian Journal of Chemistry) on *Atractylis gummifera* (XXXVI, 1906, 636) by Professor Angelico, who had made some investigations for another purpose. The direction of the botanical garden at Palermo drew the attention of Dr. Edward Marckwald, of Berlin, to the subject. He corroborated the assertion that the gum of this plant contains a great deal of rubber. His analysis follows:—

Lost by drying	4·24 %
Mechanico-organic substances	1·40 %
Albuminoids	4·07 %
Inorganic substances	2·31 %
Resins	51·52 %
Rubber	36·46 %
Total ...	100·00 %

Dr. Marckwald expressed the opinion that there is a brilliant industrial future awaiting *Atractylis gummifera*, being of the opinion that it would be easy to extract from it a merchantable product. At our request, and for the purpose of confirming this result, other analyses were made by Michelin and Torrilhon, French firms of note in the rubber manufacturing field, who found the percentage of rubber below that shown by the first analysis. It should be added, however, that these latter analyses were made from very impure raw material, just as it is obtained from the plant, and not from carefully selected material, as the former one had been. Nevertheless, the quantity of rubber obtained in the latter tests is high and sufficient to encourage the development of the plant.

The house of Michelin obtained from their sample the following result :—

Ash	2·57 %
Rubber	22·92 %
Residue	23·09 %
Soluble Resins	51·42 %
Total ...	100·00 %

This analysis was accompanied by the following remarks: "In order not to injure the rubber in the preliminary drying we operated the product just as we obtained it, so that in our analysis the water that may have been contained in the raw material has been reckoned in, by difference with the vegetable residues or insoluble minerals. The other three figures were obtained directly." This analysis shows the product to contain a certain quantity of rubber, but mingled with at least double its own weight of resin.

The house of Torrilhon, on their part, wrote : "The density of the sample is 1·037 at 15° Centigrade [=59° F.] A treatment with boiling water removed from it 4·18 per cent of a substance which, after the evaporation of the liquid part, is hard, brittle and of a brownish colour. It is made up of albuminoids which do not coagulate in boiling water. In the insoluble part are found

albuminoids which were coagulated by boiling water; this substance is whitish and possesses a certain elasticity which disappears after a few days. It is soluble in petroleum ether, leaving an insoluble residue which forms 6·14 per cent of the substance washed. This residue is made up of albuminoids which coagulate in boiling water and of the remains of vegetable matter. In the solution made by petroleum ether acetone precipitates a substance, darkish on the outside, whitish on the inside and elastic. This is the rubber and it forms 22·965 per cent of the total product. The evaporation of the mixture and of acetone gives a yellowish dense resin, which makes up 55·232 per cent of the substance washed. To sum up, the following is the result of the analysis:

Insoluble matter	6·140 %
Rubber	22·965 %
Resin	55·232 %
Water	15·663 %
Total ...	100·000 %

CULTIVATION.

The *Atractylis gummifera* is a plant apparently without a trunk, pushing out leaves down to the ground, opening out like a rose and having large clusters of flowers; on these latter in particular are produced, by the work of a lipidopterous caterpillar which perforates them, numerous drops of gum, variable in size, and easy to gather. But the greater part of the plant is found underground, where it has a trunk of enormous dimensions, often a yard or more in length, cylindrical in form, 8 inches in diameter, and weighing at maturity from 20 to 40 pounds.

The upper part of this trunk is divided into several very slender branches with numerous buds; each branch ends in a crown of flowers. The trunk contains a quantity of perfectly white, acrid latex which coagulates slowly in the air, forming a gum rich in rubber.

To sum up, the natural supply of *Atractylis gummifera* in the whole Mediterranean region might be utilized by gathering the gum which exudes from the clusters of flowers, or by causing a

flow through incision made at a proper time; but we think the largest result would follow the manipulation of the roots, which might be handled by machinery and treated by washing, as is done in the case of the rubber plant and also of the guayule in Mexico.

When we take into consideration the hundreds of square miles covered by the *Atractylis gummifera* and the enormous size of its underground trunks, it must be conceded that large quantities of rubber could be extracted from them, and that it would be justifiable to set up a plant to recover it. Years would pass by before the natural supply in the Mediterranean region would be exhausted and in the meantime, nothing would prevent suitable cultivation of the *Atractylis gummifera.*

In fact, this plant which grows and thrives naturally in the Mediterranean region, preferring a dry soil and resisting the longest drought, is far safer to cultivate than many other foreign plants which give a better yield, but are not yet acclimated in southern Europe. The cultivation of the plant would not be very costly; we could from experience point out an easy means of propagating it. The slender branches which are found almost on a level with the soil and which bear numerous buds could be removed and set out. These cuttings take root rapidly, while the buds develop leaves, so that plants are rapidly produced which in a few years yield new trunks.

We do not consider that the gum of the *Atractylis* could take the place of rubber even of average quality, but from the experiments which we have caused to be made and from our study of the subject we believe this gum to be adapted to mix with rubber, as are those of guayule, pontianak or almaidina. We propose to recur to the subject later and show the part that *Atractylis gummifera* might eventually play in the rubber industry.—(*India Rubber World*).

ORIGINAL ARTICLES.

THE FOREST OF THE TERAI AND BHABAR GOVERNMENT ESTATES, IN THE UNITED PROVINCES.

The Terai and Bhabar Estates comprise that part of the Naini Tal District which is situated at the foot of the Himalayas on the northern edge of the Gangetic plain. The word 'Terai' is well known and is loosely applied to a large part of the submontane tract, but the writer believes that the term 'Bhabar' is local and that there is no word in use in other parts to correspond to it, indicating that the Bhabar formation is perhaps unique. The Naini Tal 'Terai' is also of a peculiar character, so that some description of these tracts may be of interest, particularly if it should elucidate any information about similar formations elsewhere.

The 'Bhabar' lies immediately at the foot of the outer range of hills. It is a deposit consisting chiefly of boulders and sand, of considerable depth on its northern edge diminishing in thickness as it slopes to the south until the almost level plain is reached at its junction with the Terai. The maximum breadth of the Bhabar is about 14 miles—its elevation at the foot of the hills is about 1,600 ft. and on its southern edge about 700 ft. above sea level. In parts the surface of the ground is strewn with loose stones and boulders and the soil is so full of them that ploughing is often impossible. As one proceeds towards the south the deposit consists of increasingly finer materials. The Bhabar is traversed from north to south by numerous torrent beds over which the floods from the hills pour during the monsoon, causing large areas to be covered in the dry season with arid sand and boulders. Owing to the porous nature of the deposit only a few of the longer hill streams contain a sufficient volume of water in the dry season to cause perennial streams to flow above the surface, the water from the smaller streams disappearing into the ground within a short distance of the hills. This absence of surface water is the outstanding peculiarity of the Bhabar. The whole tract with the exception of

the torrent beds was at no very distant date covered by forest growth of varying density.

The drainage water from the hills, percolating under the surface of the Bhabar, re-appears at the lower edge of that deposit and forms the "Terai." The peculiarity of the Naini Tal Terai consists in its extraordinarily numerous streams and marshes, forming a belt of country which, with its enormous growth of rank grass, is almost impassable from east to west even on an elephant, unless recognised tracks are followed. Some six or seven miles from the edge of the Bhabar these many small streams have merged into a few larger ones, the country between these begins to differ little in appearance from that of the ordinary cultivated district of Upper India and the Terai proper has come to an end, although the southern boundary of the Naini Tal district has not been reached. Further, these peculiar features of Bhabar and Terai do not distinguish the whole area of the Government estates, which bear those names from the Sarda River westwards for about eighty miles. The description applies only to some thirty miles.

It appears that four factors will influence the character of the Terai to be found at the foot of the Himalayas—

1. The quantity of the rainfall in the hills immediately above the Terai.
2. Whether these hills are well wooded or the reverse.
3. The presence or absence of a Bhabar.
4. Whether the Bhabar is or is not covered with forest.

Unfortunately the writer is acquainted with a very small part of the submontane region, and so can only claim to do little more than speculate on the subject.

In the case of the intensely water-logged Naini Tal Terai, there is at a very short distance from the plains a range of hills exceeding 8,000 feet, the lower slopes of which are densely wooded. This high range causes a local rainfall of about 100 inches. Between this range and the Bhabar there are lower hills all densely wooded and bearing some of the finest forests in the United Provinces. We therefore have a comparatively large rainfall of which a minimum may be said to pass away at once in monsoon

torrents, while much that rushes down the outer slopes and torrent beds of the hills is absorbed by the Bhabar as by a sponge and filtered slowly through to the Terai.

In the eastern part of the estates and in the adjoining Reserved Forests, factors (1) and (2) remain the same, but there is no Bhabar. Here indeed are Terai streams but much less numerous and the whole country is less water-logged. Again in the Bahraich and Gonda districts of Oudh where British India continues to the foot of the hills, we find no hills exceeding 3,000 feet in height for some distance from the plains, the rainfall probably does not exceed 50 inches, the northern slopes of the hills are treeless, and there is but a narrow dry tract at the foot of the hills and that much less porous than the Bhabar. Below this the so-called Terai differs but little from the rest of the Gangetic plain. I believe that further east in parts of Bengal a true Terai country is found—if this be so, and there is no Bhabar, a sufficient cause may be found in the enormously increased rainfall and semi-tropical forest growth of the Eastern Himalayas.

A feature of the Naini Tal Terai which at once strikes the eye is the large proportion of the tract which is covered by nothing but grass. Often for miles the only tree growth is on the banks of the streams. Some of the smaller grass covered areas are marshy depressions but the centre of the larger ones is generally a watershed between two streams. I notice that Mr. Lovegrove in his exhaustive official report on the estates forests attributes these treeless areas to a practice of shifting cultivation by aboriginal tribes in comparatively recent times. This is an extremely probable cause, but it is also possible to seek causes in a much remoter period. I believe there are historical records of a time when the present Nepal Terai north of the United Provinces was a healthy tract possessing large and flourishing towns. If we can go back to such a time when perhaps the forest and rainfall conditions in the hills were different; when the detritus from the hills had not yet formed more than a narrow and insignificant Bhabar; when in consequence there was no Terai, we may suppose that the treeless plains are a legacy of a very ancient cultivation. It is certainly

hard to find adequate reason for their non-invasion by tree forest, but it is noticeable that many areas of cultivation abandoned in recent times are at once invaded by thorny bushes followed by a forest of *Bombax malabaricum* and *Butea frondosa*, while these comparatively high-lying grass plains remain treeless. On the other hand, the theory of recent shifting cultivation hardly accounts for such thorough going forest clearance. Further the cessation of the Bhabar deposit is generally strongly marked above these grass areas by a cessation of forest growth of the types peculiar to the Bhabar—we find these Terai streams rising in open grass land while a mile or so lower down the streams are surrounded by dense forest. Why should shifting cultivation have been so destructive to the forest at the head waters of the streams while leaving that lower down untouched ? But if this grass land be the unchanged remains of the country of pre-Terai days and we find parts of it now intersected with streams yet still unclothed with the forest, the absence of forest on drier parts need not cause us surprise.

Whatever then the history of present conditions in the Terai, it cannot be denied that the tract must form an invaluable source of water-supply to the districts to the south, and that any serious diminution of its water-supply and water holding capacity must have far-reaching and disastrous consequences. It forms moreover a grazing ground of growing importance to the more densely populated tracts below. It is from this point of view that the forest policy of the estates is chiefly interesting.

We have yet to deal with the fourth factor presented as influencing the character of the Terai, namely, whether the Bhabar is or is not covered with forest. It has been already stated that the whole Bhabar was at no remote date covered with forest. It will not be necessary to enter into arguments with readers of the *Indian Forester* to prove that the utility of the Bhabar as a 'Terai-former' must be increased by forest growth. It is of course impossible to form any exact estimate of the value factor No. (4) compared with the first three, but it is a fact that since about 1860 very large clearances of forest in the Bhabar have taken place,

Photo-Mechl. Dept., Thomason College, Roorkee. Photo by Gulab Rai.

Tikri Sal Forests, Gonda Division, U. P. under Coppice with Standards.

Coupe II felled in 1888-89.

that in quite recent times the springing of the Terai streams has receded at least half a mile to the south and that the water level in the streams is said to be appreciably lower. The irrigation officer of the estates goes further than the writer in attributing a large water-supply in the Terai to Bhabar forests and mentions a tract of country lying about 8 miles south of the Siwalik hills, east of the Jumna, which was plainly Terai in recent times but is now dry. Between this tract and the hills there is a highly cultivated country which was formerly under forest. Other factors may be at work to lessen the amount of water in the Terai but they will not even, if discoverable, depreciate the importance of the Bhabar forests. One possible factor may be noticed by the way, namely, the use since 1860 of nearly the whole of the water in the perennial streams emerging from the hills, for irrigating the Bhabar fields. In this way much more water than before must be lost by evaporation. It must not be forgotten moreover that the period which has seen forest destruction in the Bhabar has been that of a considerable improvement, by protection, of the forests in the outer hills, which should have increased the water-supply for the Terai, thus rendering the results of destruction in the Bhabar the more prominent. To understand the forest problems, a short summary of the recent history of the estates will not be out of place. Until 1858 cultivation in the Bhabar had been confined to a few fields on the edges of the perennial hill streams from which a few hillmen drew water by small canals of their own construction. Owing to the porous and sandy soil, cultivation in the Bhabar is impossible without irrigation. In 1858 Major (afterwards Sir Henry) Ramsay became Commissioner of Kumaun and by initiating the construction of numerous and far-reaching small masonry canals, gradually brought considerable areas of the Bhabar under cultivation. Much useful work was done in freeing the valuable forests in the lower hills from cultivation by compensating the hillmen with land in the Bhabar, so that the policy has not by any means been all loss from a forest point of view. At the same time the greater part of the valuable sal forests in the Bhabar were 'Reserved,'

Unfortunately the hillman is most exorbitant in his demands for timber, fuel and grazing and most reckless in his methods of satisfying his wants. The importance of the Bhabar forests, other than sal, was not much considered at that time, so the hillmen were further persuaded to cultivate the Bhabar by almost unlimited license in the forests. Later on, in 1882, a large part of the forest was disastrously affected by an enormous concession to the Rohilkhand and Kumaun Railway Company. It is only fair, however, to the authorities at the time to say that the most obnoxious features of this concession were introduced in London.

One or two causes have however been at work to preserve in fair condition considerable parts of the forests. Firstly, the size of the blocks of cultivation is limited automatically by the amount of water available for irrigation. Secondly, the hillman though destructive is very lazy about the distance he will go for wood and very particular about the size and quality of the trees he will use. As a result the destruction has been confined largely to a zone round the blocks of cultivation and in these zones there are still many trees left as being unsuitable for fences, ploughs or houses. On the other hand the graziers of the large herds of buffaloes burn, lop and fell far and wide and in the summer all the cattle are taken to cattle stations in the depths of the forest, and new centres for destruction are thus formed.

About ten years ago all the remaining sal forests except a few insignificant areas were put under the Forest Department. The rest of the Bhabar forms an estate worked directly by the Local Government, much as if it were a private owner, having only an indirect concern with Government. In 1900 the Bhabar Estate management was amalgamated with that of the Terai and was placed under a superintendent who was not chosen from the ranks of Government officials. The whole is under the control of the local Deputy Commissioner and Commissioner.

The Bhabar is an extremely prosperous and valuable estate. It will therefore be readily understood that the curtailing of forest rights and interference with customs, with a view to protection, is

a matter which must be approached with considerable caution and in which progress must be slow.

A large part of the Terai Estate does not concern us as it lies outside the Terai proper. It appears that in the early part of the 19th century under the Kumaun Rajas, the Terai was in a much more flourishing condition than it is now. During the period before British administration became settled the estate declined in prosperity—canals and drainage works fell out of repair and areas lapsed into marsh and unhealthiness which had previously been populous. From 1860 the resuscitation of the Terai Estate was in the hands of a very able administrator, Mr. MacDonald, who not only re-organised the irrigation system and enormously increased the area under cultivation but had very sound views on forest protection. He formed large fuel and fodder reserves which were to be kept free from cultivation and some of which were subject to fire-protection and other protective rules. They were however not brought under the Forest Act and after Mr. MacDonald's time, they were encroached upon and the protective measures fell into disuse.

It is probable that too much has been done in the past in the way of disturbing the water-supply from the Terai by drainage and canals in the Terai itself, in the effort to encourage cultivation in every possible corner of an essentially unhealthy tract. However that may be, it is now the policy of Government to retain the upper portion of the estate as forest, that is the Terai proper, and to discourage the honeycombing of these invaluable grazing grounds with patches of cultivation. As long as the area is not drained it must hold the water coming from the Bhabar and therefore the actual presence of trees is of far less vital importance than in the Bhabar. We have already seen that a large part is treeless and likely to remain so, while the population is scanty and much less destructive than the hill people : the trees are mostly of inferior value and the growth where it exists is often very dense and regenerates freely, so that the preservation of the existing forest is far less difficult than in the Bhabar. At the same time the pressure of the population on the resources of the forests is severe locally and

requires careful regulation. The subject of the better protection of the estate's forests has been continuously before Government since 1896 if not for the reasons set forth above, at any rate on general principles of the importance of forests and because there was a visible danger of the Bhabar tenants eventually running short of timber; at least their difficulties in obtaining wood were increasing yearly. A proposal made in 1896 by the then Conservator of the Central Circle, to make all the forests 'Reserved,' but to leave the administration in the hands of the Deputy Commissioner was rejected by Government. From various causes it was not until 1903 that Mr. Lovegrove, Deputy Conservator of Forests, was deputed to make proposals for the better management of the forests. This report led to the introduction in 1905 of Chapter IV of the Forest Act and to the appointment in 1906 of a Deputy Conservator to the charge of the forests, to work directly under the orders of the Deputy Commissioner.

In the Bhabar there are three main classes of forest land :—

(1) Lands which are still subject to the action of the monsoon torrents.

(2) Lands at a slightly higher level though below the general level of the Bhabar, but no longer subject to floods.

(3) Lands out of reach of all comparatively recent torrent action.

On class (1) we find dense growths of immature Shisham (*Dalbergia Sissoo*), and Khair (*Acacia Catechu*) either pure or mixed together. Such forests spring up with great rapidity and are often wasted away again before reaching maturity.

On class (2) we find forests of the same type in a much more advanced stage. Generally they have opened out and other species have been introduced, such as *Ulmus integrifolia*, *Bombax malabaricum*, *Adina cordifolia*, *Odina Wodier*, *Moringa pterygosperma*, and *Mallotus philippinensis*. Shisham, however, is often absent and occasionally Khair. *Ulmus integrifolia* is all but universal and often forms pure crops. In these forests *Adina cordifolia* forms the most striking feature, being represented by enormous trees of no small value—here alone are smaller trees of this species to

be found. There is usually a dense undergrowth of evergreen shrubs.

On class (3) there are many types of forest growth but three in particular may be distinguished :—

(*a*) Sal forests.

(*b*) Mixed forests of a type very similar to that first described.

(*c*) Mixed forests in which what may be called the riverain species, particularly Shisham and *Ulmus integrifolia* are absent, while Khair is less common.

(*a*). The sal forests in the Bhabar are, with the exception of a few scattered patches, confined to a large area on its western edge and another large one on its eastern edge. The crop is generally a very fine one. The reason for sal not being more widely distributed is not to be found from casual observation and forms a most interesting problem.

(*b*) These forests again are notable for *Adina cordifolia* but young trees are absent. It seems to be an established fact that the seed of this species is incapable of germinating successfully except on freshly turned soil or on quite recent deposits. The presence of the species on the lands of class (2) which have been in their present state for no long period, is therefore to be expected, but the distribution of large trees of the species about the lands of class (3) is not easy to account for. The species occurs in the forest of type (*c*) as well as in type (*b*) but is by no means universal. If we give these fine old trees an age of 150—200 years, it would appear that conditions in the outer hills and the Bhabar must have altered considerably even in that comparatively short period. Over the areas where large trees are now found, floods and fresh deposits of detritus from the hills must have been then taking place.

(*c*) Under this head come many classes of crops differing considerably in constitution and density. The following species are found pure or as the principal species. *Bombax malabaricum, Lagerstrœmia parviflora, Anogeissus latifolia, Mallotus philippinensis and Zizyphus Xylopyrus* while other common species are *Odina*

Wodier, *Casearia tomentosa*, *Kydia calycina*, *Hymenodictyon excelsum*, *Terminalia belerica*, *Phyllanthus Emblica*, *Ægle Marmelos*, *Ficus religiosa*, *Bauhinia malabarica*, *Holarrhena antidysenterica*, *Cassia fistula*, *Sterculia colorata*.

The area of absolute plants in the Bhabar forests is small, the only extensive ones being the torrent beds. The growth of grass is usually moderate in height and density even where there is no shade.

Where the Bhabar forests are not bounded on the south by the grass plains, previously described, we find a belt of forest where the Bhabar and Terai types are mingled, proceeding further south the species characteristic of the Terai form a larger and larger portion of the crop until the Bhabar species disappear altogether. The principal of these Terai species are *Butea frondosa*, *Garuga pinnata*, *Eugenia jambolana*, several species of figs, *Trewia nudiflora*, *Putranjiva Roxburghii* and *Celtis australis*. Two species particularly characteristic of the intermediate belt are *Stephegyne parvifolia* and *Cedrela Toona*. In this belt, grass of enormous size is met with. The tree of the Terai *par excellence* is *Butea frondosa*; such forests as exist between the streams are composed largely or entirely of this species. For a brief season in the year these forests present a sight of real magnificence, but the brilliant orange blossoms on the leafless twigs are a sight too well known in most parts of India to need any description. *Bombax malabaricum* forms no small part of the crops.

The dense forests round the streams abound with the Terai species already named and with many rarer ones absolutely unknown to the ordinary experience of United Provinces Forest Officers. Dense masses of cane and thorny bamboos are found and through them the dark baleful Terai waters flow silently over their treacherous beds.

Sal forests are not found in the part of the Terai which we are especially considering but in the eastern part of the estates where a modified Terai approaches almost to the foot of the hills, there is a large area of fair sal forest, principally poles. This area was "Reserved" at the same time as the residue of the Bhabar sal

forests. In the Terai south of the more eastern part of the Bhabar, there are a few high-lying areas, one of them of considerable size, under sal forest. The density and height growth of the sal are good but a large proportion of the trees are peculiarly distorted and of unhealthy appearance.

The vested interests of the Bhabar tenants form an obstacle to complete measures for the protection and improvement of the Bhabar forests, which it is impossible to overleap. It has been decided to leave all but the sal forests open to grazing, and we cannot at present do more to prevent overfelling than limit the operations as far as possible to real necessities. Blocks of considerable size, however, have been demarcated, within which the markings are to be on sylvicultural lines only. The object of management will of course be to provide timber for the tenants rather than for sale, that is to say straight poles of small or medium size are chiefly required. To determine principles of tree marking in ruined or partly ruined forests of so many different types, still exposed to so many destructive agencies, is no easy matter nor is there in the United Provinces much experience of the treatment of such miscellaneous crops to draw upon. With the valuable sal forests of necessity claiming the first attention of the Forest Officer, such miscellaneous forests as have been "Reserved" in the Bhabar and elsewhere in the submontane tract, have received but scant notice. Such forests are steadily increasing in value so that forest research and the productions of literature being now on a sound basis, we may hope before long to have more information available. I believe there are many parts of India where forests not unlike those I have attempted to describe are the Forest Officer's sole care—there much experience must have been gained.

A system of coppice with standards would appear the natural one to adopt, but in a forest exposed to heavy grazing and constant fires success seems more than doubtful. The coupes cannot be closed to grazing for even a few years after felling and were that not so, the system of temporary closure is not one in which the writer puts any confidence whatever. Mr. Carr, from the Bundelkhand Division of the United Provinces, states that coppice fellings

in forests open to grazing have had results very far from encouraging. Mr. Lovegrove, in his report on the Bhabar and Terai forests, recommended a system of improvement fellings on the analogy of those adopted for the preliminary treatment of deteriorated sal forests, but it has been found in practice that this analogy is not very helpful. Sal grows naturally in dense crops in suitable localities and the marking officer has at least some vague idea of the ideal which he is striving for. In the miscellaneous forests the greater number of the prevailing species are light demanders of different degrees, so that our ideas of a normal sal forest are of no assistance. We have then to determine for several different types of forest—to what extent the incompleteness of the canopy is due to natural causes and to what extent to destruction through human agency. Certainly not more than two gregarious shade bearing species are to be found in the Bhabar, causing mature or semi-mature crops to resemble sal forest in density—these are *Ulmus integrifolia* and *Mallotus philippinensis*. In the central belt we must add *Trewia nudiflora* and *Putranjiva Roxburghii*, but with the exception of the forests on the Terai streams, open crops are more usually found over the whole tract. Another great difficulty arises from the fact that several of the most valuable species do not regenerate under the parent tree. *Adina cordifolia* has already been alluded to in this respect—it is the same with *Shisham* and to a very large extent on the older deposits with *Khair*. It would seem that many areas now valuable from the presence of these three species must pass through a period when the only crop will be of small and valueless trees and such quickly growing species as *Bombax malabaricum*. The crops with the most promising future before them are those of which *Lagerstrœmia parviflora* forms an important part. This species is much valued by the tenants and regenerates with great freedom. Its worst enemy is frost from which it suffered terribly in 1905 and perhaps more in 1906. The frost of those two seasons caused much havoc in the Bhabar and Terai, two other of the commonest species also suffering severely, namely *Mallotus philippinensis* and *Zizyphus Xylopyrus*.

Fire-protection is a subject of great importance for these forests and is not uncontraversial. As regards the forests in which heavy grass is abundant, several officers are of opinion that fire-protection is worse than useless. They base their opinion on the theory that regeneration cannot force its way through the immense tangle of unburnt grass. Of the soundness of this view the writer has considerable doubts; even if strictly true, it is equally certain that no regeneration results from burning, while such grass is very far from being universal over the whole area. There are many patches and belts of tree forest under which the grass is moderate or non-existent—in these the fires do great damage and prevent their gradual extension into the more grassy areas. The writer has been told that similar forests in Assam have benefited greatly from fire-protection. Over the Bhabar proper the grass is not heavy and the benefits of fire-protection cannot be doubted.

We have already stated that the forests are to remain open to grazing. This leads us to another point of view of fire-protection. In forests open to grazing it must be most arduous and precarious, causing much expenditure of time, money and involving the management in ceaseless warfare with the cattle owners for whose very benefit the forests are kept open. Fire-protection with grazing implies a contradiction in objects of management which to the writer it appears well nigh hopeless to attempt to reconcile. It would be most interesting to have any records there may be from other parts of forests open to grazing having been successfully fire-protected. Mr. Lovegrove's working scheme divided the miscellaneous forests into four coupes. This arrangement will serve its intention of enabling a rapid experience of the whole area to be gained without committing the administration to a permanent scheme based on insufficient data. The obvious difficulties to which such a short felling period gives rise need not therefore be taken too seriously. The experience gained during the four years may be used for the construction of a scheme with a longer period but still not as long as that of the ordinary working-plan for sal forests. Ten years will be sufficient to provide for in our present state of trial and error.

It will thus be seen that the forest work to be faced by the management of the Government Estates is of real and growing importance, and that not merely for the local reasons which claim obvious notice. Many interesting problems await the forest officer and the future is full of great possibilities for his skill and care. In the meantime he must be content with very slow progress and to make his way steadily through masses of petty administrative detail without being caught altogether in the meshes; at the same time cautiously endeavouring to avoid the many large obstacles raised by conflicting interests.

F. F. R. CHANNER.

SANDALWOOD AT SEA-LEVEL.

I concluded my article under the above heading in the *Indian Forester* for March 1908, with the suggestion that the largest available sandal trees in sea-coast towns such as Madras, Cannanore and Calicut might be examined for scented heartwood. Since writing it, I have come across an article on 'Sandal' published in the *Indian Forester*, Vol. IX, page 62, above the initial F.B.D.—presumably of Mr. F. B. Dickinson who was, I believe, in charge of the Coorg Forests for a number of years. In the first paragraph of that article, he says:—"A few trees may be seen on the coast at Cannanore planted in gardens. I do not know what the age of these may be, but one which I examined seemed to me to have as good scent as any growing on higher land, so that it might be well worth while for Government to make plantations of it on the coast." This being a piece of confirmatory evidence of undoubted veracity of the development of scent in trees grown on the sea-coast, I hasten to draw attention to it.

2. The world's supply of the East Indian Sandalwood is almost wholly confined to South India and that the supply is not sufficiently abundant to glut the market is proved not only by the steady rise in prices during the last 10 years and more, but also by the steps that are being taken by the Mysore State and the Madras Forest Department to increase the area under Sandal.

Moreover there is every reason to apprehend that the terrible "Spike-disease" which is rapidly spreading to all Sandal areas in South India will seriously cripple our resources of that valuable product. It is therefore none too soon to take up in earnest the special conservancy and protection of the sandal tree wherever it occurs *naturally.* The Forest Officers concerned and the Madras Board of Revenue are therefore to be congratulated on the recent restoration of this valuable tree in the South Canara District to the *list of reserved trees* from which it had been excluded for some years on the ground of non-development of scented wood!

BANGALORE : M. RAMA RAO.
26th March 1908.

TIKRI FORESTS, GONDA DIVISION, U. P.

Sal poles form the chief crop of the forests and the associating species are :—*Asaina* (*Terminalia tomentosa*), *Dhau* (*Anogeissus latifolia*), *Asidh* (*Lagerstrœmia parviflora*), *Piar* (*Buchanania latifolia*), *Kumbhi* (*Careya arborea*) and *Tendu* (*Diospyros Melanoxylon*). *Mahua* trees are also met with. The undergrowth consists of various species chiefly *Chitania* (*Zizyphus Xylopyrus*), *Dudhi* (*Holarrhena antidysenterica*), *Maini* (*Randia dumetoram*), *Kusraut* (*Flemingia Chappar*), *Marur phal* (*Helicteres isora*) and *Khijur* (*Phœnix acaulis*). The roots of the latter supply food to poor villagers during famine.

The soil, generally a sandy loam, although well suited for sal of moderate size, which is much in demand for the construction of village huts, will not, it is believed, ever produce big timber of that species.

The original working-plan for these forests was prepared for 20 years. This period came to an end on 30th June last.

This working-plan dealt with an area of 12,216 acres. This formed one working circle and was divided into 20 coupes of which one was felled annually, sixty standards being reserved per acre. Its prescriptions were duly carried out. Climber cutting was the only work of improvement done during the currency of the working-plan.

The revised working-plan which has been sanctioned from the 1st July last deals with an area of 13,456 acres. The treatment prescribed is coppice with standards on a rotation of 25 years combined with improvement thinnings at mid-rotation. Climber-cutting, improvement thinnings and sowing up of blanks in the annual coupes are prescribed as the means of generally improving the crop. Forty standards are to be reserved per acre.

Plate 17 shows Coupe I in which fellings are in progress.

Plate 18 shows Coupe II in which the coppice will be only 20 years old when it is felled next year.

GULAB RAI.

JANAKPUR:
30th March, 1908.

LEAVES *VERSUS* FLOWERS.

Nature, whilst denying the trees of the ever-green zone the gift of producing showy flowers, has amply compensated the loss by the wonderful variety of colour which she allows them to display in their young leaves during the season of re-robing. In fact the shades of scarlet, carmine, pink, magenta, copper, bronze, brown, yellow, green, and purple are so various; and, lying against the dark green leaves of yester-year, are so conspicuous, that any additional show of gay flowers would be a superfluity. Flowers alone do not make a garden; and there are many who prefer a nice collection of crotons, and other variegated foliage plants, tastefully disposed, to a bright display of flowers. In the one case it is the mellow beauty of the moon, in the other, the glory of the mid-day sun.

Of all the trees of the evergreen zone, the "Sagade" (*Schleichera trijuga*) is the most conspicuous and beautiful object in this vast expanse of "God's eternal green". When the young leaves appear, early in January, they are of a bright scarlet colour; and, as if they would show themselves to the best advantage, they congregate in bunches at the ends of the branches. The leaves of the old flush are now very dark green and form an admirable back ground. The attention of the most casual observer is

arrested every now and then by these scarlet bunches; and it seems incredible that they are composed of leaves and not of flowers. As the days go by, the scarlet changes to carmine, pink, salmon, copper, bronze, brown, yellow, yellow-green, and bright green; but the transition, which begins at the base, and proceeds to the apex of the leaf is so gradual, and the shades of pink, copper, etc., appear so imperceptibly and in such beautiful order, as to bring about variegation. The Sagade then looks like a gigantic bouquet; and the crown being naturally somewhat rounded only intensifies the resemblance. If the tree was lovely in its simple dress of scarlet and dark green, it is superbly attractive in its "coat of many colours". But to appreciate this beauty the tree must be looked at through a powerful pair of binoculars, during the early hours of the morning, when the sun has just recently risen, or at early even-tide. And if it stands amidst trees with dark green foliage, and on a hill slope having an eastern or northern aspect, so much the better. In such a situation, on a small hill just behind the Inspection lodge at Biste, there are a dozen or more of Sagade trees in all the charm of new foliage, and looking at them through my glasses brought to memory certain scenic photographs which I had viewed through a realistiscope, years ago. The resemblance was complete; and it brought back the past so powerfully as to make me really feel quite old.

Another beautiful tree of the evergreen zone is the "Balege" (*Pœciloneuron indicum*). The leaves are long and delicate; the venation is parallel and very close, and the undersurface is silvery. A dead leaf looks exactly like a bit of pure silk, and makes a good book-marker. The flowers, unlike the inconspicuous ones of the "Sagade" are large, about 1½ inch in diameter, white, 5-petaled, and very sweet scented. The young leaves appear with those of the "Sagade"; but they do not blush quite as scarlet nor do they affect all their variegations. But being long and delicate, they are very beautiful things as they glisten in the sunshine.

The very young leaves of the "Hagain" (another giant of the evergreen zone) appear in magenta frocks; and being large

(a fully matured leaf measures 9 inch by 4 inch) they are very conspicuous. The flower is white, about ¼ inch in diameter, and sweet scented. The "Hagain" seems to be the peculiar property of that awful little wretch the jungle red ant, whose every bite causes a swelling.

All leaves are not born in scarlet: those of the mango make their début in the colour of royalty, a very rich purple, which changes to bronze, brown-green, and green. In their young life the leaves of the mango possess a degree of polish which the foliage of few other trees can boast of.

The leaves of the "Sampege" (*Michelia Champaca*) and "Honge" (*Pongamia glabra*) are content to appear in a light shade of green; while those of a certain *Ficus* assume a very rich copper.

Truly there *are* "tongues in trees"; but the trouble is that we do not try or care to hear the lessons they would teach.

Somebody has asked—

"If Nature put not forth her power
About the opening of a flower,
Who is there that could live an hour?"

The same question may also be asked of the young leaf.

RODERICK RANDOM.

CURRENT LITERATURE.

QUARTERLY JOURNAL OF FORESTRY FOR APRIL 1908.—The original articles in this number include :—

"Notes on some Irish Woodlands" by W. R. Fisher. These notes appear very opportunely. The Report of the Irish Forestry Commission has recently been published, and a considerable amount of attention is being paid to the question of the introduction of scientific forestry into Ireland. From the notes it may be seen what a grand opportunity is offered by Ireland for the raising of forests and there is in fact hardly a country in the world which has a climate so well suited for growing trees.

"The Planting of Sand Dunes at Holkham," by D. Monro, indicates the possibility of the reboisement of such areas. Within 50 years all the sand hills on the Holkham demesne, forming a tract three miles long have been successfully planted up. The best all-round tree for this work is found to be the Corsican pine. On northern or sea exposures the Austrian pine is useful while Scots pine answers best on the landward side. These are the only three species which have been planted now for many years.

"Hainault Forest" by A. P. Grenfell. In this an interesting account is given of this property which was acquired under a special act of Parliament by the London County Council in 1903.

"The Conversion of Ash Underwood into High Wood" by W. R. Brown.

FORESTRY AND IRRIGATION FOR APRIL 1908.—The treasurer's report published in this issue shows that the American Forestry Association is on a flourishing condition. There was a balance in hand of 6,906 dollars on 31st December 1907. An account of "Arbor Day—The American Spring Festival" is contributed by W. Caufield Lee. An article on "Californian Irrigation needs Forest" appears by Lewis E. Aubury.

There is in addition a great deal of instructive matter on various subjects connected with Forestry; the most noticeable being on "Draining the Swamps," "Protection to American Industry," "The Canadian Forestry Association Meeting" and "The Meeting of Lumber Manufacturers."

FISH-INSECTS.

Fish-insects are too well known to Anglo-Indians to need description. We all have seen the flat, scaly, shining creature, over an inch in length, which is found lurking among papers that have lain long undisturbed in some out-of-the-way place. We have remarked its fish-like shape and noticed its three long caudal stylets.

Fish-insects belong to that primitive order of the hexapoda called Thysanura. These creatures have no wings, but many of them can run with great rapidity. Their life history is simple. They undergo no metamorphosis. They pass through no larval stage. The young ones are miniatures of their parents. The order Thysanura is divided into two sub-orders, popularly known as the spring-tails and the bristle-tails. Fish-insects belong to the latter sub-order and to the family Lepismatidæ.

Fish-insects are not by any means confined to India. They appear to be found all the world over. As long ago as 1665 R. Hooke, a Fellow of the Royal Society, gave a graphic account of the creature. He describes it as " a small white silver shining worm or moth, which I found much conversant among books and papers, and is supposed to be that which corrodes and eats through the leaves and covers. Its head appears big and blunt, and its body tapers from it towards the tail, smaller and smaller, being shaped almost like a carrot. . . . It has two long horns before, which are straight, and tapering towards the top, curiously ring'd or knobb'd and bristled much like the marsh weed called horse's tail. . . . the hinder part is terminated in three tails, in every particular resembling the two longer horns that grow out of the head. The legs are scal'd and hair'd." Everybody knows how rapidly books, papers and photographs deteriorate in this country unless they receive constant attention. Anglo-Indians, with one accord, blame the fish-insects for this damage. It is true that no one has ever caught a fish-insect *in fragrante delictu*. But that is not surprising, for the fish-insect is a creature of the night, coming out from its lair, like rats and blackbeetles, only when the lights are extinguished. There is however strong circumstantial evidence

against the fish-insect; he is always to be found near the place where the offence has been committed.

The men of science equally with "the man in the street" shares Mr. Hooke's view that fish-insects are injurious to books.

Mr. Blades in his work, entitled "The Enemies of Books" writes "there is too a small silvery insect (Lepisma) which I have often seen in the backs of neglected books, but his ravages are not of much importance." The American entomologist Packard, states that the Lepismatidæ are sometimes injurious to papers and books." According to him *Lepisma domestica* has injured books in the library of Wellesley College.

The Anglo-Indian entomologist, Mr. E. P. Stebbing, believes that the fish-insect "perhaps does the most damage in libraries and to pictures. In the latter it apparently feeds upon the saccharine matter used in mounting the picture in its frame."

Sir J. E. Tennant, however, holds a very different opinion of fish-insects, believing them to be most useful creatures. He describes them as "foes who pursue and feed greedily upon" the hordes of minute insects which destroy books. He adds "instead of their services being gratefully recognised these insects are popularly branded as accomplices in the work of destruction. One of these ill-used creatures is a tiny tail-less scorpion (Chelifer), and the other is the pretty little silvery creature (Lepisma), called by Europeans the fish-insect. Like the Chelifer, it shuns the light, hiding in chinks till sunset, but is actively engaged throughout the night feasting on the acari and soft-bodied insects which assail books and papers. There are thus two opinions regarding the character of the fish-insect. One is that the fish-insect is a hexapod without guile, a poor dog who unjustly has been given a bad name; the other is that the fish-insect is the arch-enemy of our books and pictures. It behoves us to decide which of these two views is the true one, for upon the result arrived at our policy towards the fish-insect should depend.

I have given some attention to the subject and have held each view in turn. At one time I was orthodox in the extreme, then I became heterodox and was inclined to side with Tennant; more

mature experience has, however, convinced me that the fish-insect is no friend to man. Let me recount the reasons for these changes of opinion. One day I discovered in an old box, which contained neither books nor paper nor indeed anything but dirt, a fish-insect. It is true that it was not of the ordinary species. Its body was black with the exception of a white band running transversely across the hinder part of its back. As the old box was in an empty room, this discovery seemed to show that some fish-insects, at any rate, can get along without paper or books.

On a subsequent occasion in Madras, I saw a dark-coloured fish-insect emerge from the crack between the bricks and the lintel of a gate in a compound wall. It is fairly obvious that that particular fish-insect did not feed upon paper.

Then again, the fish-insect is obviously not the cause of those round holes often found in the leaves and covers of books. Some of these excavations are nearly an inch in length. The mouth of the fish-insect is not an instrument capable of boring such a tunnel. Nor is the shape of the tunnel that of the Lepisma's body.

I then determined to capture some fish-insects and keep them under observation. This resolution seemed to have the effect of producing a dearth of fish-insects in a locality where previously they had appeared to be exceptionally abundant; many days elapsed before I managed to secure one. If any person desires to rid his house of Lepismidæ I advise him to make a collection of them. They seem as difficult to collect as five-pound notes! Having at last secured my fish-insect I placed him in a square cigarette box, with a paper of a book, which was already riddled with holes that were the handiwork of some insect. I selected a book of this description, as I am assured that the paper which helps to form most of our modern books is loaded with lead and other impurities to such an extent that the life of the book-worm is now scarcely worth living. The fish-insect did not appear to be enthusiastic over the paper. I had him in that box for three weeks during which the paper remained altogether unaffected. On the second day of his captivity I introduced into his cage a dead mosquito which did seem to excite his curiosity. Later I actually

saw him with the corpse of the mosquito in his jaws. After that I used almost daily to put into his box some small insect which I had previously killed. On the twentieth day he was as lively, as hale and hearty, as when he was first captured, and as I have said before, the pieces of paper were not touched. After I had had him for about ten days I placed in his box a piece of the paper which makes the foundation of the back of a book, but the fish-insect did not take the least notice of it. When it ran over it, it did not stop to investigate.

On the twentieth day I caught a second fish-insect, a smaller one than my first capture, and introduced it into the box. The two creatures ignored one another so long as I observed them. A fish-insect abhors the light, it is therefore difficult to observe his habits. Although these insects took no notice of one another while I was watching them, they must have played high jinks after my back was turned. It happened that I did not close the box tightly, the consequence was that my fish-insects had disappeared by the next morning. There had probably been an elopement during the night! I went to England on leave shortly after that. On returning to India I was posted to Lahore where fish-insects seem to be unusually scarce. Hence my researches were at a standstill for a long time, during which I held a good opinion of the fish-insect, going so far as to make the following public declaration: "I believe that the fish-insect does prey upon the insects which attack books, also upon any other soft-bodied creatures he is able to catch. It is possible that he does soil and stain books when he is lying up in them during the day. This I believe is the worst that can be said against him." But, alack and alas! I have since been disillusioned. I am once again among the company of the orthodox. It happened in this wise. Last July I went for ten days to Mussoorie, where I was given a dressing-room which contained anything from twenty to a hundred fish-insects. I had not been three days in the place, before I noticed that the label on my bottle of quinine tabloids was growing beautifully less. Some tissue paper that my wife had put on a shelf became literally riddled with holes in an

incredibly short space of time. The same fate overtook some muslin which had never been used. The fish-insects also played havoc with some new hats that had come out from Home and were being stored up for some great occasion. The tulle in the hats was the attraction; it was this that rapidly became riddled with holes; no other part of the hats was touched.

The Mussoorie fish-insects also did considerable damage to the covers of some books which were bound in what publishers describe as "linen."

The glaze on these proved the attraction. In order to keep out the fish-insects my wife placed quantities of naphthaline and black pepper in her boxes, but this seemed to attract rather than repel the hardy creatures! The above-enumerated articles alone were touched. It is evident that whatever the fish-insect may eat in the way of insects, *it is injurious to the covers of books if these* contain any kind of glaze. It does not do much damage to the leaves of books, even when these are glossy, because it cannot get at them. Anything starchy appears to be particularly palatable to fish-insects.

There are, of course, many species of fish-insects, some of which are probably purely insectivorous, and hence not to be regarded as pests. *But* the common fish-insect—the *Lepisma domestica*—of India is assuredly not a creature to be encouraged.—(*D. D. in the Indian Field.*)

THE DESTRUCTION OF WILD ANIMALS IN THE CENTRAL PROVINCES DURING 1907.

(CONTRIBUTED.)

The report on the extermination of wild beasts and venomous snakes in the Central Provinces for the year ending the 31st December 1907 seems to point to a steady decrease, probably due to the preventive measures employed, in the human mortality under these heads.

Tigers killed 86 persons, a figure which, though 21 in excess of that of the previous year, is much lower than the average of the

past 6 years and the total number of deaths from wild animals has fallen by 31 in each of the last two years, the figure for this year being 231.

Snakes killed 996 persons against 1,100 and 1,280 in the two previous years. The resolution speaks of the extended distribution of the Lander Brunton permanganate lancets; but again notes that no reliable information has resulted from the experiment, as in cases where the treatment has been tried the snake has not been preserved. Major Wall's excellent pamphlet * on poisonous snakes has been supplied to all dispensaries and this should be of great assistance in the identification of specimens. While agreeing with the principle of first killing the snake then looking to see if it is poisonous, we would like, if possible, to examine the snake that bit us before operating on our calves, for poisonous genera are comparatively few. The classification into poisonous and non-poisonous snakes is simply and clearly described in the above treatise which should find a place in every bungalow.

The number of cattle killed was 15,228, an increase over last year of about 1,000, the Chanda District alone supplying 3,083. The feeling that rewards for the destruction of tigers should be abolished is gaining ground: in one district report it is actually suggested that they should be preserved. Man-eaters of course would always have special head money.

A curious case of a man-eater is reported from the Balaghat district. A Gond was treed by a tiger, rescued by a large body of villagers and then snatched away from the rescuing party as it was returning home. Such tenacity of purpose is more common among panthers than tigers. It has been decided to fix the maximum reward for a panther at Rs. 25 instead of Rs. 15 as formerly.

The extraordinary rise in the number of wolf skins brought in for reward and the fact that nearly 60 per cent were of cubs have led the administration to suspect that the district officers may be unwittingly fostering a new industry.

* The Poisonous Terrestial Snakes of our British Indian Dominions and how to recognise them. By Major F. Wall, I.M.S., C.M.Z.S. Price Rs. 2. Published by the Times of India office.

The licensed guns for the protection of crops now number 13,334, an increase of 165 over last year's figure. No steps are taken to protect the game in the hot weather when no crops are on the ground, and when owing to the scarcity of water in the forests the animals are forced to drink in the village tanks outside, over which the local officers have no jurisdiction as regards shooting. These tanks are the happy hunting grounds of the villager, who, from a pit dug near the edge of the water, shoots a large number of animals every summer and wounds many more. That deer, buffalo and bison in many places, even in some of the most jungly—are being steadily exterminated, those who knew the Central Provinces 15 or 20 years ago and now, can vouch for. The scarcity of game in the forest probably is the cause of the increasing mortality among cattle, as the tigers, deprived of their local supply, are driven to seek their food in the village lands and grazing grounds. We suggest that an experiment, based on this theory, be tried in one or two districts. Either all the No. XI guns might be called in on the 1st of March and re-issued on the 1st of July or no new licenses might be given for guns whose barrels were over 18" in length. Sportsmen might also be prohibited from shooting deer in the closed district, more to impress on the people the genuineness of the experiment than with the idea of putting a check on the very small amount of damage permit-holders do. On the contrary, the presence of permit-holders in a block as a rule does great service in checking poaching and this prohibition should not be enforced without very careful consideration. At least five years would have to elapse before any conclusions could be drawn. The present physical conditions are abnormal. The underground water level of the southern portion of the Central Provinces at any rate has sunk very considerably during the last decade, probably owing to the three or four years of very short rainfall, with the result that numberless pools and little springs in the forests dry up now every hot weather which formerly gave water for man and beast throughout the year. It will require the same number of years, possibly many more, of unusually heavy rains to bring the water up to the old level again.

Again enormous numbers of animals died in the great famine of 1900.

There are therefore exceptional grounds for the early consideration of the introduction of protective measures, and we trust that the Local Government will not delay taking steps in this direction on the off chance of a Pan-Indian Game Law coming into force in the near future.

EXTRACTS FROM OFFICIAL PAPERS.

BUDGET DEBATE IN THE GOVERNOR-GENERAL'S COUNCIL IN MARCH 1908.

Extract from the Speech of the Hon'ble J. O. Miller, C.S.I., Member of Council in charge of the Department of Revenue and Agriculture.

"Under the head of Forests for the coming year the Budget provides for an expenditure of 150 lakhs and for receipts of 276. The total area of Reserved and Protected Forests now amounts to 102,514 square miles, and there is a further area of 131,137 square miles known as 'Unclassed Forest'. This is a branch of administration the importance of which is certain to go on increasing. I do not refer to the importance of its contributions to the treasury; they are not to be neglected, but they represent only a small part of the benefits to the country which forestry confers. The necessity for the preservation of forests for climatic reasons is every year becoming more widely recognised, as the emphatic remarks which have been made by the Hon'ble Tikka Sahib of Nabha show. This is the one Department to which we may look for some direct effect in preventing drought. I do not mean that forests will necessarily increase the actual rainfall in the country as a whole. It is not merely the total rainfall that we have to consider, but its distribution and retention of moisture in the soil, the prevention of floods and of the erosion of mountain slopes, the maintenance, as far as possible, of a continuous and equable flow of water in our rivers and streams. The benefits of Forestry in these

respects cannot be easily measured, and next to them may be placed the necessity of maintaining a continuous supply of forest products for the use of the agricultural and other industries of the country. For this purpose it is unfortunately necessary to place restrictions on the access allowed to the forests; the very existence of the forests is incompatible with unlimited rights of user: you cannot both eat your cake and have it. Hence it is that we hear of the oppressiveness of forest regulations; they must necessarily be to some extent oppressive when forests were formerly treated as if they formed an inexhaustible source of supply. But experience in the best administered forests goes to show that by the exercise of tact and sympathy, by careful attention to the real wants of those who live in their immediate neighbourhood, and by strict control of the subordinate establishments and improvement in the class of men employed, it is possible not merely to avoid friction and causes of grievance, but even to interest the local population in the management and maintenance of forests."

"We have now established a Forest Research Institute at Dehra under a body of capable workers, and there is no service more enthusiastic in the prosecution of their work than the officers of the Forest Department. They will now be able to work out in the country itself the higher problems of Indian Forestry, and to give to the future staff of the Department that higher training for which, in the future, there is certain to be a great demand."

Extract from the Speech of the Hon'ble Tikka Sahib of Nabha.

"I am not well acquainted with the results of the activities of the Forest Department, but I think it is obvious that some more tree-planting could be effected in India. If enquiries were made, I believe there could be found waste tracts and hill slopes in various parts of the country which might be made to bear rain-attracting trees. Since the introduction of railways into India and also on account of the gradually increasing population of the country, and the wants and restless activities of large communities,

there has necessarily been great destruction not only of isolated trees in village tracts, but of whole forests, and I am not aware that re-afforestation has kept pace with destruction. Should the Government feel itself unequal to the task of increasing the activities of the Forest Department, much could be done by encouraging agriculturists to plant trees as boundaries or when opening new wells, or on spaces which are not deemed suitable for other forms of cultivation. The advantages of such a course could be easily explained to them and no serious objection would be made. The attention of Native States, such as those in Rajputana, which are the constant theatres of devastating drought, might also be called to this matter, and I feel sure they would gladly respond. Several parts of Rajputana are now unfortunately in an arid condition though they were in former ages irrigated by the copious waters of the *Saraswati* from the Himalaya mountains. That the rainfall and the temperature of a country are favourably affected by trees is a matter so commonplace and so universally admitted that I need not dwell on it here."

NOTE ON THE NATIONAL IRRIGATION CONGRESS HELD AT ALBUQUERQUE, NEW MEXICO, SEPTEMBER 29—30, OCTOBER 1—3, 1907.

BY EDWARD D. MCQUEEN GRAY, COMMITTEE ON FOREIGN REPRESENTATION, SIXTEENTH NATIONAL IRRIGATION CONGRESS.

The National Irrigation Congress, now recognised as possibly the leading factor in the agricultural development of the United States, was inaugurated seventeen years ago, and assembled for the first time at Salt Lake City, Utah, in the autumn of 1891.

The policy instituted at this Congress and maintained at the subsequent assemblies, has resulted in some of the most valuable economic developments affecting the cultivable area of the United States that this age has witnessed. Among those developments must be given the first place to the Reclamation Service, which came into existence to carry out the provisions of the Reclamation Act of 1902, and whose operations, actual and prospective, embrace schemes of greater magnitude with further-reaching results than any similar enterprise heretofore undertaken by a single nation. The forest service, whose beneficial operations in regard to the conservation, reclamation and development of forested and afforestable land areas form one of the most valuable assets of our National progress, was in a great measure brought into existence through the sentiment in favour of Federal protection for National timber-bearing districts disseminated by means of the meetings of the National Irrigation Congress; so that this association may justly claim to have been instrumental in bringing about two of the most important legislative enactments that have come into effect since its inauguration.

The business of the National Irrigation Congress is the consideration of all questions relating to the reclamation of wholly or partially unproductive land, physically capable of profitable cultivation, with especial reference to those areas within the semi-arid districts of the west, including those whose existing partial productiveness may be artificially enhanced. This land reclamation movement having started in the west, where the chief difficulty in

the way of profitable land tillage in the scarcity of moisture in the soil, rather than the excess thereof, the deliberations of the Congress have been entirely confined to irrigation, rather than drainage, as a means of land-reclamation, and to enquiry as to the most effective method of bringing additional moisture to the soil instead of withdrawing any from it; and the operations of the Reclamation Service are in effect those of a Federal Bureau of Irrigation. This distinction should not be lost sight of when the work of land-reclamation in this country is compared with operations conducted towards the same end by other Governments.

The actual work of the Congress is both theoretical and practical; the physical circumstances which have resulted in arid or semi-arid soil conditions are carefully studied and, as far as possible, segregated and differentiated; the means whereby those conditions may be wholly or partially altered and the production of economically valuable vegetable organisms insured, either by restoring as far as possible the previous physical conditions through afforestation, or by mechanical devices for the supply of additional moisture, or by a combination of both methods, are passed under review, critically evaluated according to their local environment and appraised.

The work of the preceding years, as performed by the Reclamation Service and by the most important private enterprises, operated throughout the West, is reported to the Congress by the officers of the Reclamation Service and of the private companies; and these reports, accurate and concise, which acquaint the members of the Congress not merely with the method of construction and operation employed in each case, but with the reasons for the application of varying methods in different localities and their consequent results, have formed a steadily increasing mass of experimental and scientific data on the subject of irrigation which it may be asserted, no other country is in a position to offer.

For it is most important to bear in mind, in connection with the National Irrigation Congress, that in the United States are found a greater variety of conditions calling for the application of additional moisture to the soil than in any other single country

in the world, with the possible exception of the Chinese Empire, where, for that matter, irrigation as a factor in national economics has not yet been seriously considered. In Southern California, and in some parts of Arizona, we have conditions very closely resembling those to be found in the lower portions of the Province of Bengal, the Nile Valley below Assouan, and the Barrage districts of Algeria; in California, between the Santa Clara Valley and Los Angeles, and in Southern New Mexico, the physical circumstances are very similar to those prevailing in the lower Lombard plain, and in the central portions of the Spanish Peninsula and on the Hungarian Steppes; Northern New Mexico and Colorado are much like the valleys of North Western Italy lying towards Piedmont; while in Washington and similarly circumstanced districts the conditions resemble those under which the irrigation operations of the Hydraulique Agricole in France and Meliorations-Gebiete in Prussia are conducted. These comparisons might be extended until they would in all probability embrace every known irrigation district; but enough instances have been given to show that the United States presents within its own borders physical and climatic conditions which may fitly be styled international; and it is this circumstance which gives to the meetings of the National Irrigation Congress a peculiar economic value.

VOLUME XXXIV NUMBER 8

INDIAN FORESTER

AUGUST, 1908.

THE EMANCIPATION OF THE DIVISIONAL FOREST OFFICER.

It has become obvious for some time past that, if steady progress is to be maintained in the development and management of the forests in India a vast increase must be made in the forest staff. It is, we believe, a fact, that the increase of work in the department of recent years has brought matters to the straining point, and we at any time may hear of a complete break down. More especially this increase falls on the Divisional Forest Officer whom now-a-days it is common to find, with little or no leisure at all. He is continually working all day and every day in a struggle to keep things going. The unremittent work tells on him to a marked extent, and sooner or later must cause his work to deteriorate. It is only on account of the great variety of work which the Divisional Forest Officer has to do, that he is able to carry on. As development of the forests proceeds and organisation advances, the work tends to accumulate more and more on the shoulders of the Divisional Forest Officer. Such a

Photo.-Mechl Dept., Thomason College, Roorkee. Photo by H. Jackson.

Katha manufacture in the Gonda Division, U. P.

system cannot go on much longer or, if it does, progress will certainly cease. It is doubtless a fact that we are still only at the beginning and that the scope for progress in forest work is quite unlimited. We maintain that if steady progress is to continue, some radical change must be made either in the increase of all branches of the staff, combined with a repeated process of sub-division of charges, or by a complete re-distribution of duties. The former may, we think, be left out of consideration, for to start with, it is extremely improbable that Government would sanction the doubling or trebling of the Imperial Staff which is what would be necessary if this line of action were adopted. This too would be against the policy of Government who, we understand, are anxious to encourage indigenous talent wherever this is feasible. The complete re-distribution of duties remains therefore as the remedy which we must strive for, and this we will now proceed to consider.

The powers of the Divisional Forest Officer have recently been much enhanced by permitting the delegation of powers to him, but even this is ineffective without further changes being made throughout India. It has always been recognised that long years of work as executive officer afford little scope for the exercise of administrative talent. To obviate this a system of sub-circles was once proposed but was found wanting. What is required, we consider, is not the reduction in the size of divisions, save in special circumstances, but rather that work should be decentralized by making the Divisional Forest Officer *administer* large areas, and by making this possible, by giving him a staff of Imperial and Provincial Officers who would be in sub-divisional charges and *directly responsible to him*, thereby giving the Divisional Forest Officer a chance of proving his aptitude for administration and of improving therein by practice. At present it is not infrequent to find that Divisional Forest Officers are treated as if they were in a kindergarten, allowed no initiative, and interfered with in detail, the result being that the Conservator has more clerical and inspection work than he can get through, while junior officers having little chance of executive responsibility in sub-divisions, reach divisional charges also without practice. Such a system re-acts throughout

the Department and is most inimicable to the development of any talent that may be available.

With Divisional Forest Officers allowed to do their own work, and with Sub-Divisional Officers in defined charges, the Conservator, being no longer inundated with details, would have ample time for controlling finance and sylviculture in his circle. We consider that the system of having many small divisions is a wrong one. It emphasizes the Conservator's authority in details, it is expensive and it increases clerical labour. Large divisions, with sub-divisions, in practice, not only in theory, imposes executive authority where it should be, *in the executive officer*, and removes it from the Conservator. They provide a training ground for administrative work and offer all the advantages of the formerly proposed *sub-circles* without their drawbacks. The sub-divisions permit of the training of junior men, whether Imperial or Provincial; they afford opportunity for these to take responsibility early in their service and for showing initiative.

This system would entail a considerable increase of staff to supply the necessary number of Sub-Divisional Officers. The Imperial Staff would require some strengthening but the majority of the Sub-Divisional Officers would belong to the Provincial Staff. This latter would require to be increased greatly; moreover, as management became more intense, the expansion of the Provincial Staff would have to go on proportionately. The system advocated therefore provides just what is now wanted, *viz.*, suitable employment for indigenous talent. The third year course at the Imperial Forest College has been designed to ensure the future superior quality of recruits for the Provincial Service and by giving direct appointments to Gazetted rank, men of superior attainments will doubtless be attracted. It remains only for Government to create for them the posts which, we advocate, are now necessary for the development of the vast forest estates in the Indian Empire. The Department could readily absorb as many aspirants as can qualify for a very long while to come. Having instituted this third year course at Dehra Dun, we are duly bound to find posts for those who can pass, posts suitable to their proposed pay and possible attainments.

The system we suggest would provide just such posts as are required.

To make the system a success we want officers of control to be of *the very best* in scientific knowledge and other attainments, so that we may in the future have Imperial Officers taking their proper place as Directors of Forestry to a largely increased Provincial Service. Therefore we must emancipate the Divisional Forest Officer, give him full scope for work and raise his status by enlarging his duties not by restricting them.

SCIENTIFIC PAPERS.

BRITISH FORESTRY.

III.

It has been shown in a previous article that an area of somewhat over three million acres, or 4,700 square miles, is at present under woodland of one sort or another in the United Kingdom. It is proposed now to consider the condition of that woodland and the measures which must be taken before it can be restored to a profit-yielding state. This is a matter of concern not only to owners of woodland, but to the whole community, because, what with the diminished revenue from land under agriculture, the constant increase in the rates, and the crippling effect of the death duties, no landowner deriving his income solely from farm rents can afford to plant or maintain woods merely as a luxury. The time is at hand when woods in most parts of the country must be made at least to cover their expense, or disappear altogether, causing loss of employment in rural districts and the destruction of some of our fairest landscapes.

The only branches of economic and constructive forestry that have ever been understood and practised in the United Kingdom are—(1) The growth of crooked oak for shipbuilding; (2) the management of coppice; and (3) the cultivation of osiers. The last-mentioned may be dismissed from consideration for the present,

for although it remains a highly remunerative industry, yielding, in the neighbourhood of good markets, a net annual revenue of not less than £15 an acre, it is but a subsidiary branch of forestry, which, if greatly extended, would probably cause the supply to exceed the demand at remunerative prices. The first two branches above-mentioned are interdependent, the usual system followed, at least in Southern and Midland England, being coppice with standards; so that, apart from merely ornamental plantations, by far the greater part of English woodland is of this nature. It was exceedingly profitable in its day. Stevenson, writing on the agriculture of Surrey in 1813, stated that when, as was commonly done in that country, copse wood was let with the farm, it returned the same rent as the cornland adjacent; where they were let separately *the annual rent of the coppice varied from 12s. to 20s.* an acre. The standard oaks in the coppice, which were reserved by the landlord, "will run, according to quality and measurement, from £10 to £13 per load."

Now, had the demand for this class of produce continued, no better woodcraft need have been attempted, and certainly no more delectable landscape results could have been desired, for there is nothing more beautiful in nature than an English woodland of the old kind. Beautiful at all its stages, as much so when the massive foliage of the standard oaks—our national tree—towers over the dense thicket of coppice, as when the coppice is cleared away in its due rotation and the bare ground breaks out into sheets of primroses and hyacinths, rose campion, and foxgloves. But the times are sadly altered in respect of this ancient industry. Nobody wants crooked, branchy oak, but clean, straight boles; and as for coppice many a landowner might confirm the experience of Lord Harrowby, who, speaking in the Carpenters' Hall in 1904, said:—"*In Gloucestershire I have a wood of 200 acres, which was planted* some time ago with underwood, and gave a very handsome return. Fifteen or 20 years ago 20 acres produced £7 an acre, but only last winter I had great difficulty in persuading a timber merchant to give 15s. an acre." In short, a mature crop of coppice cannot be expected to realize more at the close of a rotation period

of 12 to 15 years than the sum which could formerly be obtained in rent for each year of that period, indicating a fall in value to the owner of 1,100 to 1,400 per cent. The cause of this decline is not obscure. Wire netting and wire fencing have displaced hurdles and post-and-rails; modern explosives and heating apparatus have greatly impaired the demand for charcoal, of which the manufacture still lingers in the Midlands; the baker, as was observed recently by Mr. R. L. Anderson, who used to take 5,000 faggots a year for his brick ovens, now requires only 150 or 200 for lighting up a steam oven, and gets them for 10*s.* or 12*s.* a hundred, whereas the price used to be 23*s.* or 26*s.*; oak bark, for which tanners 30 or 40 years ago paid £8 to £12 a ton, can scarcely be disposed of now at £3, which leaves little or no margin on the expense of stripping and carriage, unless the woodland happens to be close to a tanyard; and, even so, tanners prefer foreign tannin and certain chemicals, which are more rapid in process, but as many a bibliophile can mournfully testify, far less satisfactory in result. With one exception, therefore, the ancient, national craft of coppice cultivation may be regarded as finally destroyed, and we must learn how to turn the woodland to better account. The exception referred to is found in the copse-woods of pure Spanish chestnut in Sussex, which, at the age of eight to ten years, formerly yielded as much as £30 to £40 per acre, and even now the produce finds buyers at remunerative prices. The extraordinary freedom with which this tree responds to coppicing in the south makes it far superior to oak for that purpose, now that oak bark is unsaleable; and it is reported that a new industry has been established in that district of late—namely, the manufacture of a very durable and cheap kind of fencing which originated in France, consisting of wires supported on split chestnut staves.

The process of converting unremunerative coppice into regular high wood is arduous and expensive, and requires a resolute hand. No middle course is possible; the ground must be cleared and the coppice and standards sold for what they will fetch. This is being done on a large scale on the estate of Hursley in Hampshire. The coppice on this property covers upward of 3,000 acres, and

this is now being cleared off and replanted for high forest at the rate of 100 acres per annum. In 1906 the price received for mature copse on the 100 acres cleared was only £40, which would meet about two-thirds of the cost of erecting wire-netting as a necessary protection against rabbits, if we take that cost at *6d.* a running yard, and assume that the area to be planted is a regular square. If it is any other shape, the fencing will be longer in proportion to the ground enclosed. Thus the length of fence required for a rectangle twice as long as it is broad exceeds that for a regular square as 5 to 4.

The ground having been cleared of growing wood, and fenced against ground game, most proprietors will do well to take expert advice before proceeding further, because the result of any mistake made at this stage will be felt unto the third and fourth generation. By expert advice is not meant the counsel of a nurseryman, because, let his integrity and skill be what they may, he is sure to have ingrained in him the evil traditions of English estate forestry. Good counsellors are ready to come from Oxford, Bangor, Durham, Edinburgh, and elsewhere, having drawn their precepts from experience in those countries where forestry is a lucrative industry. We shall only glance here at the nature of the work to be accomplished and the surest means to success.

To tear up the stools of an old coppice would leave the ground in the best possible state for planting, but that process would be so costly that it may be dismissed as impracticable. The only alternative is to pit the ground, say at four feet apart, and plant such trees as will most rapidly overshadow and kill the shoots from the old stools. The choice of species, of course, will be regulated by conditions of soil, exposure, etc.; but keeping the question of ultimate profit in view, and seeing that the consumption of coniferous timber in the United Kingdom is four times greater than that of hard woods, in nine cases out of ten it will be found expedient to plant firs or pines. Now there are three species of conifer upon which, in the writer's opinion, the future of British forestry mainly depends—namely, the Douglas fir, the Sitka spruce (*Picea sitchensis*), and the Japanese larch, and no

other tree fulfils so perfectly as these the qualities of rapid growth and excellent timber. Old foresters will demur to my hardihood in advocating the extensive planting of exotic trees whereof the commercial value is not established in this country. They will call it a blind gamble in future; but it is not more so than the enterprise of the second Duke of Atholl, who, having received a few seedling larch from the Tyrol in 1727, planted 20,000 acres with that tree before his death in 1764, to the notable advantage of his successors. The introduction of the European larch opened a new era in British forestry; but within the last 30 years it has suffered so grievously and generally from a destructive disease that no reliance can be placed upon it any longer. Moreover, the light shade cast by the European larch will not suffice to kill the stools of old copse, which the three species mentioned above, densely branching, are well fitted to do.

But, the critics will say, granted that the Sitka spruce will thrive on almost any soil, the Douglas fir and the Japanese larch require good ground for their development. The answer is that coppice ground is always good, because, at a time when coppice was remunerative, it paid well to grow it on good agricultural land; besides which during the century or more of its growth, the annual fall of leaves has greatly enriched it by the formation of humus.

As to the prospective value of Douglas fir grown in Britain, we cannot form any estimate either from specimen trees, encouraged to form numerous strong side branches, to the utter detriment of the timber, or from the use of this tree in mixed plantations which it soon outgrows and where it gets its head deformed by the prevailing wind. Unlike the European larch, which is seldom or never found growing naturally in pure forest, but in mixture with other trees, the Douglas fir must be grown in close company of its own species. The same may be said of the Sitka spruce, which is a very rapid grower and strong brancher. Without the discipline of close company in high forest neither of these trees will produce clean timber free from knots.

Of the commercial value of British-grown Douglas fir, it is true there is little proof as yet. *Ex pede Herculem*—there is the

well-known, oft-quoted example of Taymount, where, in 1860, eight acres were planted with 2,416 Douglas fir and 7,264 larch, the Douglas fir being four years old from seed of the parent trees at Scone. This gives only 1,210 trees per acre, which means that they were planted 6 ft. apart—far too sparsely, as every forester will agree. However, the Douglas fir will take all the room it is allowed; the larches had all been cut out by the autumn of 1880, and in 1887 the further mistake was committed of felling 620 Douglas fir, which were sold for £34. The remaining 1,796 trees threw out stronger side branches than ever, to the great detriment of the timber; which, notwithstanding, in the year 1900, when the plantation was just 40 years old, a Perth timber merchant offered 9*d.* a foot for the crop standing, the price of larch at the time being 1*s.*, and of Scots pine 6*d.* a foot. This offer which was not accepted, was estimated to amount to £1,600 for the whole crop or £200 an acre.

The future of the Japanese larch in this country is even more speculative than that of Douglas fir, but nobody who has experience of its wonderful vigour in early years can fail to recognize in it a tree of brilliant promise. In its native forests, where it grows pure, it is known to produce timber not inferior in quality to that of its European cousin. As a decorative tree it is quite equal to the other; indeed, in winter the rich, warm tone of the young growth is much more agreeable than the wan tint of the European larch. Its tendency to side branching, however, indicates the necessity for growing it in close high wood in order to produce good timber.

The special merit of the Sitka or Menzies spruce is its indifference to quality of soil. Nearly as rapid in growth as the Douglas fir, it is more fearless of cold and exposure to high winds. It will thrive on sour, imperfectly drained ground where the other can make no headway, and, having a similar tendency to throw out strong side branches, it must be grown very close in order to produce clean boles. The timber is quite equal to that of Norway spruce, and is produced of enormous size, Mr. Elwes having measured one in Washington State which girthed 23ft. at 6ft. from the

ground, and appeared to be three or four feet in diameter where it was broken off at about 120ft. from the ground.

There is one objection at present to the extensive use of all three of the above-mentioned species—namely, that owing to absence of demand, British nurserymen do not keep large quantities in stock, and consequently have to charge prices which preclude all chance of profit to the planter. From Continental nurseries, however, they can be had of excellent quality and at the following rates:—

Douglas fir, three years transplanted, £16 per 10,000.

Menzies or Sitka spruce, three years transplanted, £11 per 10,000.

Japanese larch, three years transplanted, £10 per 10,000, which compares thus with English prices for the species commonly planted—

Norway spruce, 12in. to 15in., £12 per 10,000.

Scots pine, 12in. to 15in. £12 10*s.* per 10,000.

European larch, 12in. to 15in. £12 per 10,000.

No doubt, were the demand for the better species created, British nurserymen would rise to the occasion; meanwhile, they have to stock their ground with what their customers require.

Any woodland owner planting or replanting annually on a considerable scale will find advantage in rearing his own stock from seed. There are several firms of established reputation who can be relied on to supply seed of guaranteed quality. From 1lb. of giant cypress seed (*Thuja plicata*) costing £1, the writer raised upwards of 50,000 seedlings, planted out at three years old. At that age they are quoted in English trade lists at from 1*s.* 6*d.* to 2*s.* 6*d.* a dozen: in French ones at 2*s.* a hundred.

Supposing the ground cleared of copse to have been planted with one or other of these three species, the shoots from the copse stools may have to be removed by hand from round the larch in the second year, but the Douglas and Sitka firs, being good shade-bearers, may be trusted to hold their own if carefully planted at first, and, having once got a lead, they will keep it, destroying all competing undergrowth.

It has been pointed out to the writer that, in estimating in his last article, the average annual net return from German State forests in the quinquennium 1892—96, he based it on the mean of the return from the forests of each State without taking into account the difference in area. When that factor is brought in, the average net annual profit is reduced from 11*s.* per acre, as stated in the article on February 25th to 6*s.* 8*d.* per acre. It is to be noted that this refers to the returns 12 years ago, since when the progressive increase in value has been well maintained.—(*The Times.*)

ORIGINAL ARTICLES.

STERLING PENSIONS FOR THE IMPERIAL FOREST SERVICE.

(CONTRIBUTED.)

During the past year or two a feeling has been gaining ground in the forest and other somewhat similarly constituted departments, towards the substitution of sterling for rupee pensions. When pensions were in the first instance under consideration and when the scales were laid down for most of the old Uncovenanted Services recruited in Europe, the basis of such seems to have been £500 a year after 30 years' service, a little later changed to 25 years' service, with an additional £100 in special circumstances. At that time, the pension, which there is every reason to believe, was intended to be given in sterling currency, was expressed generally in rupees, as it was never anticipated that the face value of the rupee would fall below two shillings. Later on, when, owing to the rapid depreciation of silver, following on the Franco Prussian war and other causes which cannot here be discussed, ground for grave discontent was found to exist, and reasonably so, among the Indian Services, some measure of redress was forced upon the India Council. Such redress took the form, after the usual official delays,

of fixing the value of the rupee at one shilling and nine pence, if paid in Europe, in the case of pensions ; and one shilling and six pence in the case of furlough allowances. If the inner history of the case ever comes to be published, the writer has ground for believing that it will be patent that with a little more pressure from outside, the India Council at home was prepared to advise a two shilling value in the case of pensions if not in that of furlough allowances : the clamourer of the Public Services, however, more or less subsided on the grant of the above substantial though inadequate concessions, and the agitation most unfortunately dropped. It has now again been revived, owing no doubt to the increased cost of living at home, to the improved pay of various services indicating higher pension as an equitable corollary, such being regarded in the light of deferred pay on a definite percentage, and to the comparatively high pensions that promise to be obtainable by the Provincial Services, these being out of proportion to the pensions obtainable by the expensively educated home recruited services.

The Imperial Services are now asking, and the request is a fair one, that a pension be given in the currency of the country in which their members were recruited and in which they not unnaturally hope to end their days, urging also that this was the original intention when their various services were called into existence.

There appears to be good ground to agitate in the matter and for representation to be made, to the India Council, impressing upon it the justice of returning to their original intention of sterling pensions. If given to one service, such will have to be given to all, though the scale may possibly differ owing to the special circumstances of individual services. This brings us to the discussion of an adequate and equitable pension scale paid in sterling for the Imperial Forest Service.

In the Covenanted Civil Service the individual is popularly supposed to subscribe to his pension some £500, receiving £500 a year at the hands of Government. This is probably a fairly accurate estimate and again goes to show that originally the general

basis of pensions was that Government should contribute £500 a year after 25 years' service.

In the Indian Army the pension is £700 after 32 years' service and £500 after 28 years' service. As service counts from the date of his first commission, it may be assumed that a Military Officer commences his pension service at some 20 years of age, as against 22 or 23 years in the Forest and other Departments, therefore a pension in the Forest Department similar to the Indian Army pension would be £700 a year after 29 or 30 years' service and £500 after 25 or 26 years' service. Thus, again, it appears incontestable that the original basis of all pensions for home recruited officers was £500 a year after 25 years' service, or shall we say 48 years of age, the length of service being somewhat contingent on the age of admission. A pension at 20 years' service is permissible both in the Indian Army and in most of the services, the *raison d'être* of this earlier pension being no doubt the expediency of offering some inducement to retire when a man's health was such as to render further service in India undesirable, though not perhaps actually impossible from the point of view of a Medical Board: we have great doubt however as to the expediency of this earlier pension—it is generally recognized that an officer is probably nearing his best at from 20 to 25 years' service, and it appears to us poor economy and subversive of Imperial interests to give him any inducement to go then if in good health, and we have strong grounds for thinking that in the event of sterling pensions being granted, the first condition will be that no one will be eligible for a pension under 25 years' service except on medical certificate.

In some departments no doubt a higher pension than £700 a year (excluding any contribution by the individual) is drawn, *e.g.*, in the Indian Medical Service, but here it will be found that the circumstances are special, thus it may easily be imagined that a senior Civil Surgeon, enjoying in addition to his emoluments a lucrative private practice, would decline to throw up this for an administrative post, unless some inducements were offered him in the shape of an additional pension. Moreover the Indian Medical is probably the strongest service in the Empire, backed as it is by

the medical schools at home, these latter can bring pressure to bear that is unique of its kind and not possible in the case of other services.

Looking then at the question temperately, it appears to the writer that a sterling pension may reasonably be asked for, and that it constitutes an anomaly that one service recruited in Europe should be accorded a sterling pension and another not—(this anomaly in the past was not so obvious, as our Imperial Services or what then corresponded to such were then often partly recruited in India), and that a fair pension, and one which the India Council ought not with any show of justice to oppose, is £500 a year after 25 years' service, £600 a year after 27 or 28 years' service and £700 a year after 30 years' service, that is a pension somewhat similar to that of the Indian Army taking into consideration the different age of entry into the two services.

After some 27 or 28 years' service the Provident Fund accumulations of an officer ought to purchase a pension in a first class life office of some £250 to £300 a year, so that under the scale of pensions advocated above, an officer, retiring after 30 years' service, might well count on about £1,000 a year, and thus be enabled to pass his declining years in a manner befitting the position he was holding on his departure from India.

As regards special pensions it seems fair to ask that an officer who has put in three years as Conservator be eligible for a £700 pension whatever his length of service, because in the first place, owing to men of the same standing being now held to be of equal seniority, selection for the administrative posts must soon take place to a greater extent than at present, and some special distinction appears indicated in the case of an officer selected for peculiar merit, while in the second place, it is, in the opinion of the writer, more than doubtful whether an officer, even if so selected, will have put in three years in the Conservator's grades at less than 28 years' total service, looking to the composition of the Imperial list; thus the concession of 28 years' service in place of 30 would be a small one and could hardly be considered as an unreasonable reward for special merit by the Secretary of State.

A still higher pension of £800 a year might well be advocated for the Inspector-General or for a Chief Conservator, again as a reward for special merit, just as a general officer is eligible for a special good service pension.

The expediency of establishing a Widows' and Children's Provident Fund should be dealt with separately, and might well be the next point to be taken up after the grant of sterling pensions. The writer of this article has carefully studied the subject and discussed it with men of wide experience and mature judgment on this and other services, and feels justified in putting forward the above proposals for the consideration of the officers of the Imperial Forest Department.

A NOTE ON THE PLANTATIONS IN THE BODYAR FIRST CLASS FOREST, JAUNSAR DIVISION.

1. Bodyar 1st class forest consists of four compartments protected from fire, aggregating 1,463 acres, of which the following is the detailed classification :—

Area with deodar as the growing stock	... 536	acres.
" " blue pine " " "	... 6	"
" " firs " " "	... 51	"
" " oaks " " "	... 69	"
Area under plantations (blue pine, deodar and cypress) ...	... 403	"
Culturable blanks ...	... 219	"
Unculturable blanks ...	... 79	"

2. The general aspect is a hot one, the soil is clay or clayey marl and there is heavy growth of grass in the blanks. The conditions were often unfavourable for the introduction of deodar and even of the blue pine, and even now one sees very sickly trees in the clayey beds of ravines and depressions where drainage is poor. On the upper slopes the conditions are more favourable.

3. Bodyar Forest forms part of a working circle having an area of 9,852 acres, and Rs. 500 yearly are allotted for re-stocking blanks and the maintenance of plantations.

4. The suggestions in the working-plan for re-stocking and sowing up of blanks are sound: Patch sowings of blue pine to start with (espacement not given but seemingly 10′ × 10′ apart, centre to centre for later, deodar are to be planted in between, making the final espacement *not more* than 5′ × 5′). Various shrubs are also suggested for propagation, to act as nurses for the deodar, such as *Desmodium*, *Indigofera*, *Berberis.*

5. But the plantation work was in progress long before the original working-plan even was thought of, ever since 1872 in fact. The results are generally good, more especially with the blue pine. The latter is now seeding and natural regeneration is springing up, so complete success and the full stocking of the blanks is now merely a question of time.

6. A plantation journal has been maintained for years back, but the total cost of the works is not indicated and early entries are sketchy in the extreme. Until the form of record is prescribed this is inevitable. The code form has drawbacks. I attach a very neat form in use in Germany (pocket book size) which is attached to the yearly Prussian "Forest und Jagd-Kalender" and is thus always at hand and available.

7. The species cultivated in Bodyar were Deodar, Blue pine, *Cupressus torulosa* and a little *Cryptomeria japonica.*

The last was only sown in the Bodyar Rest House nursery in 1898 and the 48 plants now alive average 2⅛″ girth at 4½′ from the ground and 7¼′ in height (maximum 4⅞″ and 11¼′). A few *Pinus Laricio* are also to be seen in the compound.

8. The methods used were:

Basket planting.
Sowing in nurseries and transplanting.
Sowing in lines } *in situ.*
Sowing in patches }

9. The espacement varied, Mr. Ribbentrop advocated in 1892, 4′ × 4′ and even 3′ × 3′ but from existing plantations it would appear 4′ × 4′ and 5′ × 5′ was generally adopted, the reason being that the ground was to be covered and the grass killed off as quickly as possible.

As every stick of wood is saleable in this forest to meet the demand of the Chakrata Cantonment (12 miles distant) the financial aspect of the case loses some of its terrors, but the formula $K_n = K_0 \times 1{\cdot}0p^n$ was not considered then, and is considered very little now when laying out money on cultural works, and Rs. 50 an acre at $3\frac{1}{2}$ per cent compound interest at the end of 120 years (a common exploitable age for deodar) makes a very big hole in the financial result of a deodar crop. And even estate managers on a big scale have to take such trifles into account.

10. Mr. Moir estimated the cost of basket planting (original cost) at Rs. 56 per acre and was of opinion that 80 per cent success should be attained. From figures gained by past experience the cost per hundred plants may be taken as follows :—

	Rs.	a.
(*a*) Baskets	1	9
(*b*) Seed and nursery treatment (2 years)	0	4
(*c*) Pits in forest 1′ × 1′ × 18″ ...	1	4
(*d*) Planting out	0	3
	3	4
Add 20 per cent of items (*a*), (*b*), and (*d*) for failures, say	0	6
Grand total ...	*3*	*10*

Planting out 4′ × 4′ means 2,700 plants per acre in round numbers. This is equivalent to nearly Rs. 68 per acre of fully stocked plantation, excluding cost of annual weeding and cutting back of grass, which would be necessary for 5 years at any rate, and which would cost Re. 1 per acre per annum or Rs. 5 in all. This raises the cost to Rs. 73 per acre fully established.

And Rs. 73 at $3\frac{1}{2}$ per cent compound interest at the end of 150 years (the exploitable age fixed for the Bodyar Kunain working circle for deodar) amounts to no less than Rs. 12,716·746, to be accurate. Without knowing very much about gross values of Indian timber crops per acre at maturity (which is again a little problem that forestry on a basis of estates management on a large scale is not likely to solve) it seems safe to say that 200 deodar at

Rs. 50 per tree, which are required to balance the bill roughly, (allowing a large sum to be realized for thinnings and firewood) will *not* be produced. A mature deodar of 28″ diameter according to figures in the Sutlej valley working plan would give 120 c.ft. gross. That is 200 trees would give 24,000 c.ft. for the acre. This is not a high figure for Baden or Saxony, but one which has still to be measured up to be proved true in India.

11. This note has been written as the outcome of the study of the Bodyar Plantations and Plantation Journal. The plantations have succeeded. All honour to them who carried the work through. The expensive nature of the operations has already been noted on in the Journal and there is a characteristic note by the late Mr. Hill, Inspector-General of Forests, which admonishes the Forest officer "to sow and sow and sow."

And this advice holds good now for all coniferous work in India. The poor training of our subordinate establishment, the uncertainty of what we can spend per acre without courting financial failure and the inability of a divisional officer to control such operations personally all point to the necessity of utilising the cheapest and the simplest methods.

Before undertaking big cultural works it is just as well to capitalise the proposed cost and see how the scheme works out. For deodar in our present state of want of knowledge of the ultimate value of the timber crop, any expenditure of over Rs. 25 per acre on plantations fully established would, in the opinion of the writer, be unwise.

A. J. G.

Sample Form :—For guards and foresters, etc.
Plantations and Repairs for 190.

Serial No.	Block, Forest, compart-ment, &c.	AREA TREATED.		Details of work done.	COST.	
		Creation.	Repairs.		Per job °/o etc.	Total.
		Acres.			Rs. a. p.	Rs. a. p.

KATHA MANUFACTURE IN THE GONDA DIVISION.

Owing to the premature stoppage of the monsoon last autumn and the consequent scarcity prevailing in Oudh this year, it was thought well to allow *katha* manufacture in the Tulshipur forests of the Gonda Division. This was therefore sanctioned as a special measure to provide work for the distressed poor of the district, and, incidentally, a little extra revenue.

Although the aggregate area under *khair* in these sub-montane forests amounts to a considerable proportion of the whole extent of the reserved forests of Tulshipur, the current working plan prescribes no regular working of *khair*, so that, as a matter of fact, there had been no *katha* manufactured in these forests for the last 20 years.

There was thus a considerable accumulation of workable material available in riverain areas, and also on dry elevated and broken situations, where denudation is proceeding very quickly, as shown by the fact that nearly all *khair* trees, even quite small ones, are seen standing on little but quite distinct pedestals, of earth, two or three feet above the level of the surrounding ground, showing that all the soil down to this depth has been carried away within the short lifetime of the tree. In such places the maintenance of some kind of soil cover is of the utmost importance, to check the washing away of the soil, the extension of existing, and the formation of new, ravines.

Khair is the principal species found in such elevated situations, and as such, it has a special value from a general and cultural point of view, which far out-weighs the small commercial value it has as a source of *katha*. For this reason, under ordinary circumstances, the *khair* is protected and not worked. The trees, moreover, are small, stunted, of bad shape, and generally of a very poor quality.

The local custom has always been to pay royalty on the number of pots employed, and in the present instance this method was followed. The royalty fixed was at Rs. 2-2-6 per pot (*handi*) capable of holding 7½ seers of water and 3 seers of chipped red wood. The department undertook to mark for felling by the

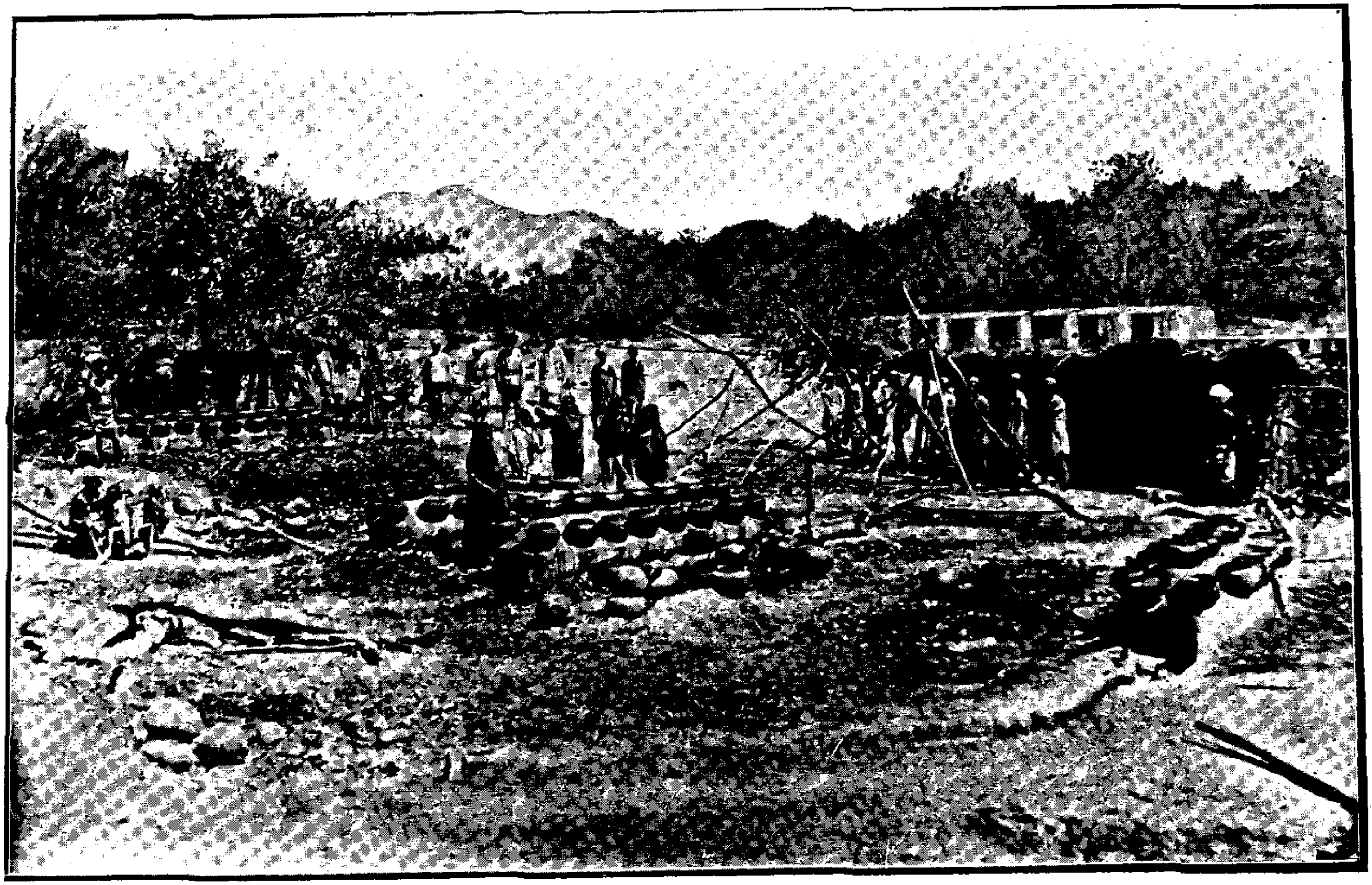


Photo.-Mechl. Dept. Thomason College, Roorkee.

Katha manufacture in the Gonda Division U. P.

contractor, as many trees as might be found available for felling, of 2 ft. girth and over, within the area.

The system of royalty per *handi* is rather wasteful, and is not to be recommended, as it is difficult to control the number of pots used. This system further facilitates breaches of the rules, because the *Khairas* are usually able to take advantage of the negligence or dishonesty of the local forest subordinates, to get the latter to put their hammer mark on undersized trees, or on trees which ought to be retained to protect the ground, etc., and also to permit them to fell a large number of unmarked trees. In these ways considerable and irreparable damage to the forest may be committed in a very short time.

It is much better to sell a fixed number of trees, of a certain minimum girth, for a lump sum, and to leave the number of *handis* alone.

The lump sum method would also prevent waste. By the royalty on outturn, or royalty-per-*handi* methods, there is no inducement to make the most of each tree, and vast numbers of young trees are felled, of which more than half of the volume is left lying on the ground, and so great waste occurs. The *Khairas* should be made to make the best possible use of the whole utilizable wood of every tree that they fell.

In the contract a clause should be introduced to the effect that within the area of forest to which the contract applies, the contractor binds himself to accept responsibility, and to pay a fine of, say, Rs. 5 for any tree found to be illicitly felled, whether it can be proved that it was actually felled by his employés or not.

As only the heart wood is used, it is obvious that as the proportion of heart wood increases with the size of the tree, it should be advantageous to deal with as big trees as possible, provided they be still sound. The *katha* manufacturers, however, prefer quite small trees of about 2 ft. in girth ; these are the easiest to fell, and the workmen maintain that they yield a better quality and a proportionately larger outturn of *katha*. It would seem, however that, giving full weight to the *Khairas*' prejudices, no tree of less than 2½ ft. girth measured at 4½ ft. from the ground, can

profitably be delivered over to them for working, without loss of economy.

The *Khairas* are a tribe of *katha* makers and cultivators in the Utraula Tahsil of the Gonda District. They also go under the name of *Chain*. The former name is obviously derived from the *khair* tree (Sanskrit *kharida*, the *Acacia catechu*). They are a mixture of various tribes such as *Bhur*, *Jogis* and low caste Mahomedans, who have taken to the pursuit of *katha* making. They are very conservative in their methods, and very unwilling to substitute new and unfamiliar methods of working, for those which have been sanctioned by immemorial custom, and handed down from father to son. They have been told that by boiling shavings of *khair* heartwood instead of thick chips, they can get a very much increased outturn but no persuasion will make them adopt spoke-shaves in place of the axe.

The following is an outline of the process adopted in *katha* boiling this year in Gonda Division.

The site selected is generally the bed of a stream where sufficient water can be had. In the last week of December the *Khairas* begin by building a temporary row of grass huts to shelter them and their families at night. In addition to this one or two sheds with open fronts are attached to each row of *chappers*. A forked stick is put up in front of the shed; this supports the top end of the trunk of the *khair* tree, divested of its bark and sapwood, the bottom end resting on a square block of wood. The tree is chopped up into small chips and as this is generally done by night, one of the wooden posts in each shed carries a lamp. A furnace of peculiar shape is then constructed. This is a raised oblong hollow construction, made of clay, with a number of round holes left in it, on which the earthen pots (*handis*) are placed for boiling the wood. In January the felling men provided with axes are sent out to cut down all the marked trees, and for these they have to search in the interior of the forests. In going through the forests these men are accustomed to cut notches into each stem whether it is marked for felling or not, in order to ascertain from the thickness of the sapwood and the colour and

appearance of heartwood, whether the tree will answer their purpose well or not. The trees after this preliminary test are then felled. The bark and sapwood are removed and used as fuel and the red trunk is carted or carried by men to the camp. The heartwood, as stated before, is chopped up into small chips about 2 cubic inches in size, which are packed in the earthen pots covered with water, and boiled in the open air. These are then placed on the openings left in the top of the furnace, and boiled for 3 hours, by which time the water is reduced to about half the original quantity and the chips are softened and ready to part easily with their gummy colouring matter. After the first boiling, a rough grating made of split bamboos is thrust into the pot to retain the chips, while the pot is inverted and the decoction poured out into a second pot standing over the same fire, in which the boiling is continued till the proper degree of inspissation is reached; the water as well as one seer of fresh chips being added again to the emptied pot. After a second boiling for a period of 3 hours the thickened decoction is again decantered into a last pot in which it is boiled down, and stirred with a wooden spoon, until the required degree of consistency is obtained. The infusion is then allowed to cool in the pot and is then put into a wooden trough about 2½ ft. long, one foot broad and 6 inches deep, and is further allowed to cool for 12 hours. This is again emptied into a pit measuring $6' \times 5' \times 5'$ dug in the ground in a clear and cool airy place. The bottom of the pit is filled with a layer of sand 6 inches in thickness in order to draw off the water contained in the thick liquid.

The *katha* is then allowed to solidify in the pit, a process which takes a variable period according to its consistency. The solidifying of the infusion is thus the result of a slow process of cooling and drawing away of the water. After about a month the *katha* when it is of the consistency of moulding clay is taken out in pieces of about 5 seers and dried in the sun. It is then cut up into small cubes and other shapes, in which it is found in the market, and further hardened by exposure to the sun.

The lower the temperature is in the pit, the better, it is found, are the results.

With the exception of felling the trees and making the chips, all the work of attending to the boiling and the fires, and changing the liquids from one pot to another, is done by women ranging in age and experience. These are generally assisted by small children.

FINANCIAL RESULTS.

The number of pots used in the Tulshipur forests of Gonda during the month of January and February was 5,132 and the average outturn of *katha* per pot during the working season of 60 days, works out to about 35 seers, containing 55 per cent. moisture.

During the season ending 15th March 1908, 38,162 *khair* trees or 7·24 trees per pot were cut, producing 76,324 maunds of red chips and 4,490 maunds 20 seers *katha* extract, an average of 6 per cent.

I ascertained as nearly as I could, the cost of making 4,490 maunds 20 seers of *katha* (= 2,020 maunds 29 seers dry *katha*) as per detail given below :—

	Rs.
Felling and chipping	18,475
Boiling	16,422
Huts	513
Drying and making cakes... ...	160
Royalty	11,066
Miscellaneous	1,347
Total ...	47,983
Selling price in the jungle at Rs. 11-8-0 per maund	51,641
Balance ...	3,658

This leaves, after deducting all expenses, a net profit of Rs. 3,658 or about 13 annas per maund.

The selling price of dry *katha* in Lucknow ranges from Rs. 25 to 30 per maund.

This work afforded employment to about 5,000 men, women and children, who were fed and financed by a trader of Lucknow.

In fact all the necessary capital for the work was advanced by this man at a fixed rate of interest, and he takes all the *katha* from the workmen at a fixed rate. He usually takes care that they shall always remain in his debt from year to year.

It is very difficult to know with anything like accuracy the proportion of the workmen's share of the profits compared with the Bania's. This man does not find it to his interest to impart correct statements regarding expenses and receipts. Thus the figures of the financial results are only approximate, and only a very rough idea can be acquired.

From the stand-point of finance I regard the position of workmen as miserable. It may be admitted that as regards the Banias, the Government is unable to induce them to take a reasonably low rate of interest. This consideration naturally leads one to the best remedy that lies in the system of making the workmen independent of, and indifferent to, the attractions of Banias, by Government giving them advances at a low rate of interest. Instead of selling the manufactured produce to a single interested individual they will learn to dispose it off in the open market for their own advantage. The present system affords a very poor return to the workmen for the energy and labour vested in it. The system, if adopted, will, it is believed, be hailed by all *katha* makers as an act of grace and generosity on the part of Government, and will have a permanent effect in shaping the future of this industry, which is one capable of a great deal of improvement.

GULAB RAI.

THE IMPERIAL FOREST SERVICE OF INDIA.

SIR,—The above is the title of an article by Mr. Nisbet in the *Calcutta Review* for January 1908. It has only come to my notice now and my object in writing this letter is to give the article the prominence it deserves, for the *Calcutta Review* is not a periodical which forest officers, as a whole, know very much about.*

* Mr. Nisbet has contributed an article on somewhat similar lines to the *Nineteenth Century and After*, April 1908, pp. 637 to 650.—HON. ED.]

It is therefore unfortunate that Mr. Nisbet should have chosen this medium to bring his views on the Imperial Forest Service before the public, views which are not endorsed by many members of the service.

It is still more unfortunate that Mr. Nisbet in dealing with a controversial subject, namely, the future education of the forest probationer, should have ignored the controversial aspect of the question by quoting from the Department's journal, the *Indian Forester*, only those articles which strengthen his arguments and by omitting all reference to articles and correspondence detrimental to his point of view.

Mr. Nisbet in the course of his article prefers a charge of *suppressio veri* against the home authorities in their dealing with the question of forest education (see page 66 of the Review) ; I wonder what verdict his present action will earn, when one takes into account the fact that his article was meant for the public, ignorant of the two sides of the question ?

To enable those of your readers who have not ready access to Mr. Nisbet's article to follow the main argument, I make the following quotations :—

"Now after all, what is Indian Forestry ? What is the best general description of the Indian Forest Officer's duties ? It is mainly estate management on a large scale. Every forest officer must admit that if he has to be classed according to the work which takes up most of his time, he is far more an accountant and a general revenue officer than anything else, and that the modern scientific German and French Forestry he has been taught in Germany or France, or Cooper's Hill or Oxford, is but of rare appliance in the great stretches of forest committed to his charge...... ...."

And again :—

"In every practical detail Indian Forestry (varying in all the Provinces) differs entirely from European Forestry. If one be forced to compare them, the former is in miniature and deals with relatively small areas under intensive management, while the latter is on a very large scale embracing vast areas that can only be treated

extensively. Thus, for example, in France there are 32 conservatorships and 236 divisions ; and the total area of all the State, communal or corporation, forests under the charge of the Department of Woods and Waters amount to 7,787,000 acres, which gives an average of about 243,359 acres or 380 square miles for each Conservatorship, and about 33,000 acres or 51½ square miles for each division. In India, however, over its whole superficies of 1,000,000 square miles there are about 250,000 square miles of State forests (reserves 100,000 square miles, and protected and unclassed forests 150,000 square miles) which are divided into 19 conservatorships or circles, and about 130 divisions. The average area of actual forest in each conservator's charge thus exceeds 12,500 square miles, and each divisional officer has charge of over 2,000 square miles on the average. But the actual territorial area included within each conservatorship averages over 57,000 square miles which is over 3,400 square miles larger than all England and Wales (50,902 + 2,682 = 53,584 square miles) ; *while each divisional officer's charge averages over 8,000* square miles, and is just about thrice as large as Wales. It is therefore easy to see that although the fundamental principles of forestry are the same both in Europe and in India, yet the differences may in many important respects be just as vast as they are with regard to the territorial and the actual forest areas committed to the care and management of the forest officers......................"

The quotations are long but they are necessary to show Mr. Nisbet's point of view.

Briefly it may be stated thus: "*Because* the present day Indian Forest Officer is largely not a forest officer but an— accountant, general revenue officer and what not besides and because he has large areas to deal with, *therefore* in his training a detailed practical knowledge of the systems in vogue in most up-to-date countries of scientific forestry in the world, Germany and France is not required."

Can we, Indian Forest Officers, hope for nothing in the future? Will not the day come when the Indian Forest Officer will be a scientific forest officer *par excellence*, when his varied duties as

accountant, general revenue collector, and so on, will be relegated to other shoulders, and when the forest division will no longer be the unwieldy area it now is?

If Mr. Nisbet answers *that* in the negative, there is little else to say and his point of view remains supreme.

But if the future policy of the Forest Department is a progressive policy, if it is recognized that driving a Divisional Forest Officer until he is invalided is uneconomical and wrong, and if divisions and circles are cut down to human workable limits, I am of opinion that we have still much to learn from Germany and France.

Intensive working means carefully prepared working-plans based on irreproachable data.

With these in our hands we may make variations on the recognized continental systems and talk of Indian forest systems.

There are none at present, and it is useless to attempt to cite any which can claim to have reached a stage of finality.

There is time enough to talk of throwing over France and Germany as practical training grounds for the future Imperial Forest Officer, and of relying largely on the theoretical knowledge of forestry that is capable of being imparted at the various universities and colleges in Great Britain with their poorly equipped chairs of forestry, for—

Forestry cannot be taught from books. Breadth of view can be acquired in India, notwithstanding previous continental training in intensive forestry; scientific forestry (in its true sense) under present conditions of work and divisional charges—never.

1st June, 1908. A. J. GIBSON.

[We believe that the Government of India are well aware of the advantages of the practical training on the continent and we refuse to believe that any proposals to do away with that training are entertained.—HON. ED.]

CURRENT LITERATURE.

INDIAN FOREST RECORDS, VOL. I, PART II. A preliminary note on the development of the Sal in volume and money-value, by A. M. F. Caccia, M.V.O., F.Z.S., Imperial Superintendent of Forest Working-plans. This record is a compilation of the data which are at present available. It will be extremely useful to those who are interested in Sal, as indicating how very little is yet known and as a guide to what points specially require elucidation.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA, BOTANICAL SERIES, VOL. II, NO. 3. A note on a toxic substance excreted by the roots of plants is published by F. Fletcher, M.A., B.Sc., Deputy Director of Agriculture, Bombay. The subject is one of absorbing interest. The author believes that the toxic substance excreted by all plants is the same, but differing only in quantity. This conclusion appears to be justified but is at variance with the conclusions derived from experiments in America.

RECORDS OF THE GEOLOGICAL SURVEY OF INDIA, VOL. XXXVI, PART 3. Among the number of papers which this part contains, we remark the following:—"The Structure and Age of the Taungtha Hills, Myingyn District, Upper Burma," by G. de P. Cotter, B.A., F.G.S., illustrated with a beautiful photograph and a map. "Two Calcutta Earthquakes of 1906," by C. S. Middlemiss, B.A., F.G.S., illustrated with a map.

A SKETCH OF THE GEOGRAPHY AND GEOLOGY OF THE HIMALAYA MOUNTAINS AND TIBET. By Col. S. G. Burrard, R.E.,

F.R.S., and H. H. Hayden, B.A., F.G.S. The first three parts of this magnificent book have been published: I, The High Peaks of Asia; II, The Principal Mountain Ranges of Asia, and III, The Rivers of the Himalaya and Tibet. Part IV, The Geology of the Himalaya has yet to appear and this part will complete the work. It is difficult to exaggerate the excellence of this publication. It is beautifully got up and is fully illustrated with numerous charts. It summarises the geographical and geological knowledge of the Himalayas and Tibet at the present time. The book is published in quarto size by the Superintendent of Government Printing, Calcutta. Price Rs. 2 per part.

CIRCULARS OF THE ROYAL BOTANIC GARDENS, CEYLON, VOL. IV, NO. *10*. White Ants, by E. E. Green. We must draw attention to this interesting account of white ants. It is illustrated with a good photograph showing the fungus gardens in a white anthill and with a sketch of the universal ant exterminator which is alluded to on page 491 of the present number.

THE BOTANICAL GAZETTE FOR APRIL, 1908. This excellent magazine publishes as usual some papers well deserving of attention, *viz.*, "The Relation of Plant Societies to Evaporation," by E. N. Transeau; and "A Quantitative Study of Transpiration" by G. L. Clapp. The first paper gives a lot of information with reference to the rate of evaporation in forests compared with other positions. The evaporation in forest, within one metre of the surface, *i.e.*, the stratum in which seedlings have their struggle with the environment, was found to be from 10 to 50 per cent of that in the open. The second paper referred to, gives the results of actual measurements of the amount of transpiration of various plants under greenhouse and standard conditions. We note that under standard conditions the daily average of transpiration of the following plants in grams per hour per square metre of leaf surface, compared as follows:—

Ficus elastica	26·28
Ricinus communis	32·75
Zea Mays	19·02

For further details we must refer our readers to the paper itself.

FORESTRY AND IRRIGATION FOR MAY, 1908. The chief item of note is the forecast of the important Conference of Governors summoned to meet at "The White House" on the 13th May, 1908. *Forestry and Irrigation* says that "never before in the history of the United States has it seemed advisable that the Nation's Chief Executive call into convention the Chief Executives of the several States. No circumstance has seemed so great; no contingency has loomed so gravely on the horizon as to make it seem necessary for the President to call into consultation the Governors of the States, for the purpose of counselling with them as to the means to be adopted to forestall threatening disaster." The question before the Conference is that of the conservation of the natural resources compared with which President Roosevelt says there is no other question now before the Nation of equal gravity.

The other articles to be noted are :—"America's Greatest Irrigation Scheme" by A. D. Cameron. "Waste of Natural Resources and Need for Conservation," by Mrs.Adams-Williams. "An Inland Waterways System," by Dr. C. B. Edwards and "Work in a Natural Forest," by C. H. Shinn, No. 7 Land, Indians and Whisky.

FORESTRY QUARTERLY, VOL. VI, NO. 1. The chief article is on "Logging by Steam" in which all the latest devices for extraction of logs are described. The paper is accompanied with numerous clear illustrations. The other more noticeable contributions are "Notes on the Girard Estate Forest Plantations." These plantations are in all probability the most interesting example of re-afforestation to be found in the United States. "Management of Spruce and Hemlock Lands in West Virginia" by Max Rothkugel, "Extending a Log Rule," by E. A. Braniff. "Structural Characteristics of some Phillippine Woods" by C. H. Goetz.

SEA BIRDS IN THEIR RELATION TO FISH LIFE.

Mr. W. P. Pycraft, of the Natural History Museum, South Kensington, recently read a paper upon "Sea Birds in their relation to Fish Life" at a meeting of the British Sea Anglers' Society Mr. Pycraft described the evolution of the bird from the fish, and said the adaptation of the fish to life on land was clearly traceable.

The earliest bird remains were known only from fossil remains found in the Jurassic formations, and showed a descent from reptiles by the long tail resembling that of a lizard. The feathers manifested themselves at the joints of the vertebræ of this tail in bunches, the foot was perfectly birdlike, the third finger as it were of the wing was the most distinct, but had a claw. The jaws had teeth. There were in existence only two specimens, one in the British Museum and the other in the Museum at Berlin. Nothing more was found until the Cretacean period was reached. Some American remains showed the development of fish which found life easier on shore, some spreading from forest to open country, some forced up rivers, some remaining on the seashore, and others, taking to the capture of food by swimming and diving in the sea. All these underwent changes as a result of the varying struggles for existence. These changes were described and illustrated by lantern slides. The evolution from the first sea bird to the shore bird and the diving bird was fully developed, and occupied probably millions of years. The lessening in size and form of the wing of the flying bird and the change it underwent till it became a powerful paddle in the swimming diving bird was ably traced and shown, and these changes were demonstrated in the grebe, petrel, albatross, guillemot, gull, penguin, cormorant, gannet, duck and osprey. The development of the beak, also, involving the disappearance of what had formerly been useful, but was no longer required, and its lengthening out into the dagger form for purposes of offence, was described. The huge gatherings of sea-birds during their breeding season was shown by some excellent slides and the extraordinary way the emperor penguin incubated, created much interest. The birds never touched land, but rested and bred upon the ice in mid-winter. They had to carry their eggs, and even their young, upon their feet, no nesting being practicable. The feathers turned over the egg, and kept it in place, and in this the male and female relieved each other in turn. The members of the Society had discussed the habit of certain fish to cease feeding during the breeding season, and much interest was taken in Mr. Pycraft's statement that a similar habit existed in the sea-birds.

They migrated in clouds to breeding grounds, which were seldom feeding grounds, and occasionally they managed to eat, but having fattened exceedingly previously, then lived mainly upon the stored fat.—(*The Indian Field.*)

THE NILGIRI GAME AND FISH PRESERVATION ASSOCIATION.

At a recent meeting of the Nilgiri Game and Fish Preservation Association it was decided to approach the Madras Government again, with a view to the Game License fee being raised from Rs. 30 to Rs. 50, with a separate fishing license of Rs. 10. This is not the first effort made to enhance the license shooting fee, and which the Government heretofore refused to sanction. However, our present Government has fallen in with the suggestion of the Game Association and have sanctioned their recommendation, so that from the 16th September next, the fee for a shooting license will be Rs. 50 for the whole of the shooting season, and a license for one month during the shooting season will be Rs. 25 and for two months Rs. 35, while a separate license for fishing will cost Rs. 10.—(*The Indian Field.*)

EXTRACTS FROM OFFICIAL PAPERS.

EXTRACT FROM THE PUNJAB GOVERNMENT'S REVIEW OF THE REVENUE ADMINISTRATION REPORT OF THE PUNJAB FOR THE YEAR ENDING 30TH SEPTEMBER 1907.

13. The forest settlement work in the Rawalpindi District has been nearly completed, and records of rights of the Kahuta and Murree Tahsils have been filed. The report of the working of the Chos Act, 1900, is encouraging, the plantations of trees and grass in the beds and on the banks of these hill torrents are a source of considerable profit to the people, and the Deputy Commissioner reports that in the hills the beds of the streams are becoming

narrower and deeper. Although the Act greatly restricts grazing in the area to which it applies, it is being administered with very little friction, and the people themselves have begun to realize its benefits, as is proved by applications received from six villages to have certain of its provisions extended to their areas. Reboisement in the hills must necessarily be a slow process, and it will be some time before its effects become manifest in lessening the violence of torrents when they reach the plains. But the results attained in the short period since the Act came into force are gratifying and His Honour will consider the advisability of extending its provision to other districts where the conditions are similar to those of Hoshiarpur.

Extract from the Punjab Land Revenue Report for 1906-1907.

Indian Forest Act and Government waste lands. (Statement No. 15).

22. Nearly all the matters of Forest Administration in which enquiry was necessary in connection with the land revenue settlement of the Rawalpindi District have now been settled. Within the year under report the area to which the rules for the conservancy of forests and jungles in certain hill districts of the Punjab, published under the Punjab Laws Act in 1879, are applicable were determined, the management of certain plain forests in the Kahuta and Murree Tahsils were prepared and filed, and preliminary questions were disposed of in connection with the proposed *guzara* rules for Murree and Kahuta.

Besides the reserved forests and other areas in charge of the Forest Department, there are in the Punjab more than 7½ million acres of land owned by the State, which is managed by Deputy Commissioners mainly with a view to the encouragement of cultivation and the regulation of grazing. Of this immense area nearly 2½ million acres have been leased to tenants under large colonization schemes, such as those on the Chenab, Jhelum, Lower Sohag and Para and Sidhnai canals; and over half a million acres have been leased for purpose of cultivation elsewhere under the rules for the lease of waste land. The remaining 4½ million acres are generally let out on grazing leases, and a large proportion of this

area will ultimately be colonised when the canals now under construction are completed.

The income from the land leased for cultivation is generally taken in the form of land revenue *plus* a proprietary due (*malikana*), and the receipts under these heads during the year amounted to Rs. 11,35,166 land revenue and Rs. 6,47,075 *malikana*. The other income amounting to Rs. 7,36,641 includes, not only sums paid for grazing leases, but payments for the purchase of proprietary rights in the colonies and elsewhere. The total income from these State owned lands has fallen from 28 to 25 lakhs, mainly owing to smaller realizations from sales of proprietary rights and town sites in the Chenab Colony.

INSTRUCTIONS REGARDING THE COLLECTION AND IDENTIFICATION OF WOOD SPECIMENS.

Inspector-General of Forests' Circular No. $\frac{8}{163\text{-}2}$, *dated* 23*rd May* 1908.

In continuation of this office Circular No. 4, dated the 18th March 1903, I have the honour to quote, for your information and guidance, the following extract from a letter dated the 17th December 1907, from the Secretary of the Advisory Committee of the Royal Society, to the Under Secretary of State for India :—

"The Committee hopes that it will be impressed upon those who collect specimens of forest products, and especially wood specimens, that such specimens are quite worthless unless they have been botanically identified with accuracy. Recent experience in the examination of wood specimens received from the Indian Forest Department through the Superintendent of the Royal Botanic Gardens, Calcutta, has shown that this is by no means always the case. It is essential that when products, including woods, are prepared for transmission to those who will investigate them, they should be accompanied by botanical specimens obtained from the very same plant, and vouched for by officers of experience and responsibility. If the collection is left to subordinates, there is danger of carelessness, and this leads to waste of money and time."

2. I would be glad if you, with the permission of your Local Government, would impress upon the officers under you the urgency of complying with the above remarks. They equally apply to specimens that may be sent to the Director, Botanical Survey of India (*vide* my Circular No. 24—303-10, dated the 28th December 1907), and to other officers engaged in investigation and research.

3. Where, however, specimens are indented for by commercial firms, business men and others with a view to test their trade possibilities, it will be generally sufficient to send the actual specimen asked for, *e.g.*, where a timber sample is indented for, it would be superfluous to send also specimens of the flowers and fruit. These are in this case evidently not required, and in order to obtain them, delay might often take place in complying with the indent.

THE UTILIZATION OF SILT IN ITALY.

[*Supplementary note, dated 20th December 1907, by Sir Edward Buck, K.C.S.I.*]

Under the instructions of His Majesty's Secretary of State for India, I have made further tour in Italy for the purpose of accompanying and assisting Mr. C. Hutton of the United Provinces, Irrigation Department, deputed by His Honour the Lieutenant-Governor, United Provinces, to make an examination of Italian methods.

I am not called upon to submit a report myself on this occasion. That duty devolves, I understand, on Mr. Hutton but I ask permission to forward a few remarks, supplementary to what I have already written, which I ask the favour of being officially appended to the file, and, if considered desirable, circulated to those Governments and authorities to whom my previous report was sent.

There are, as I explained in my report, two separate systems of "colmate" or silt depositing—

(1) Colmate in the plains and low-lying valleys.

(2) Colmate in the ravines and broken lands on hill sides.

The first are carried out very extensively by the Public Works Department of the Government, in valleys and low land generally between the mountain ranges and the sea, covering some hundreds of square miles, and to a lesser extent, by private owners with or without Government aid: in some cases, notably that of the Val di Chiana also inland—some 800 square miles in this case.

Examples of this system of "Colmate" were visited by Mr. Hutton and myself at or near Foggia, Capua, Grosseto, and Ravenna. The rivers utilized in these tracts are not in character like those of Upper India, being as a rule more like meandering canals, the level of whose beds is either higher than or not much lower than the surrounding country and valleys into which therefore the water containing silt can be easily led.

The system adopted resembles, I understand from Mr. Hutton, very much that which is followed in North India in forming "silt traps" which to a comparatively small extent have been constructed in the neighbourhood of canals. How far this system may be extended in the vicinity of canals it is not for me to suggest. But I would wish to point out that the character of the rivers, in the tracts we have seen, appears to assimilate more to that of the rivers in Lower Bengal and perhaps elsewhere, whereas in Italy the bed of the river itself is very slowly raised between well defined banks, and that anything like an approximate imitation of the Italian system of turning the river water with its silt, either by deviating the river or by canals from it, would more easily be effected there than in Upper India.

Still the problem of utilizing silt, wherever it can be profitably utilized, is one which can probably be solved by engineers under the various conditions which exist in the north dissimilar as they may be to the conditions on the Italian seaboard.

I am myself disposed to revert to my original suggestion, *viz.*, to make use of silt, when it cannot be conveniently employed, for filling up depressions, for the purpose of manuring cultivable or culturable lands, in other words, by covering the fields from time to time with a veneer of fertilizing matter. This principle is

already involved in the early irrigation of rice tracts in the United Provinces by the Canal department; but might, in my opinion, possibly with advantage, be extended to areas which are not rice tracts.

I explained in my former report that the Agricultural authorities in Italy strongly advocate this plan.

At Ravenna we saw it applied in the case of rice during the process of filling up the depressions. Thus a stratum of silt was added in the winter and rice grown on it in the summer.

I am the more inclined to revert to this, my original suggestion, in that all that I have now again seen points to the essential importance of using river water, only when it is full of really fertilizing matter; and that condition, in the streams coming from the Himalayas, may exist only for only one or two days or perhaps only a few hours at the very first heavy downfall of rain. Thus these streams may only furnish in the course of the year a mere veneer of silt for the land to which it is applied. As I reported last year, even at Ravenna, where there are five or six independent spates or flushes, silt is only deposited for some fifty hours in the year. Nevertheless even this amount is thought well worth preserving by, in this case, private owners, whose land is by it improved to ten times its original value.

I will now advert to the second system: The "Colmate di monte" or utilization of silt in the hills.

I had seen no instance of this in my former tour. The "novel system" which I sketchily described in my report was devised by the land agent of the Marquis Ridolfi—the grandfather of the present Marquis Carlo Ridolfi—but a proposed visit to his estate was prevented by a death in his family. On this occasion I wrote the Marquis who was good enough to invite us to spend a day at Melito (between Pisa and Florence) when we were taken over the ground by the manager of the property.

The transformation, which had been effected over a very considerable area, made a great impression on both Mr. Hutton and myself. A series of formidable ravines had been converted

into systematically drained broad terraces of fertile fields by the removal (through the agency of judiciously directed and well controlled rain water) of earth—for it can hardly be called silt, from the useless and unculturable ridges of the upper hill sides into the ravines hollows. I will not attempt a detailed description of the process, which must be seen to be properly understood, though there exists a sufficiently large literature on the subject which is of great assistance to any competent engineer who may have the opportunity of inspecting the ground.

It is unfortunate that the time at our disposal did not admit of a more prolonged examination of the system, or of a visit to other estates, where, I was informed by Professor Giglioli of the Pisa University, an authority to whom I have referred in my report, it is carried out to a still larger extent, notably near Siena.

My object in mentioning this circumstance is to suggest the desirability of a further and closer examination of the system by competent engineers. I need hardly say that the plan cannot be adopted, unless the earth torn down from ridges and prominences is of culturable quality. But in such cases as those of the Jumna ravines it is believed that a great deal of fertilizing matter is carried to the ravines from the cultivated lands alone (as in the case of the small reclaimed ravine area near Cawnpore which I described in my report) which can in addition to the earth of the ravines themselves be utilized.

USE OF DRIED COW-DUNG AS FUEL IN INDIA.

The common practice among the natives of India of using air-dried cow-dung as fuel has frequently been condemned on the ground of the loss of the nitrogenous constituents, which are of value as manure, and samples of this material have been sent to the Imperial Institute recently for examination with a view to ascertaining whether or not the calorific value of this material is high enough to warrant its use in this way now that coal is becoming relatively cheap in many parts of India.

The sample consisted of flat cakes of air-dried material, containing fragments of dry fibrous vegetable matter and a considerable proportion of soil.

The examination of the sample gave the following results—

Calorific value ... ... 2045 calories.*

			Per cent.
Phosphoric anhydride ...	P_2O_5	...	0·46
Lime	CaO	...	4·88
Magnesia	MgO	...	0·94
Potash	K_2O	...	1·60
Soda	Na_2O	...	0·68
Nitrogen	N	...	0·04
Ash		...	52·96

The calorific value of the dry cow-dung is therefore about one-third of that of Indian coal, which generally ranges from 6,000 to 7,000 calories.

The manurial value of the cow-dung in the condition in which this sample was received is very small, and the only constituents of manurial value lost by its combustion are the small amount of nitrogen and the organic matter, since the phosphoric acid, potash and lime become concentrated in the ash left after burning.

No information was supplied regarding the methods employed in preparing the dung for fuel, but apparently most of the manurial constituents have been removed either before collection or during the process of preparation. Presumably the dung is not collected for fuel until it has become dry and combustible by which time the bulk of the soluble manurial matter has probably passed into the soil. It is obvious from the above results that if the sample submitted for examination is generally typical of the dried cow-dung used as fuel, the utilisation of the material in this way entails very little loss of manurial matter, and is probably the most economical method of disposing of it. The ash might be employed as a manure.—*(Bulletin of the Imperial Institute.)*

* 1 calorie is the amount of heat required to raise the temperature of one gram of water from 0° to 1° C., so that one gram of this material when thoroughly burned will raise the temperature of 2,045 grams of water from 0° to 1° C.

GRASS MATCHES IN INDIA.

One would have thought that the prices of the foreign-made wood matches had got to such a low level that substitutes could not be found to compete with them, but advices from India state that a Match Factory at Sholapur is using Surya grass, the supply of which is inexhaustible and the cost insignificant, instead of wood. A chaff-cutter, set at 2 inches, cuts the stalks to the required shape, which are then winnowed to get rid of grass, etc. These are then passed through two horizontal sieves, which retain only those stems that are of the correct thickness. These are then boiled in paraffin for five minutes and dried in a revolving drum. Some 24lbs. of Burma paraffin go to 7,000 boxes of matches. They are then shaken through a horizontal sifter, which deposits the stems in horizontal layers. These layers are then put into a screw frame and the stems are now in a horizontal position, held tight by a screw, and are then ready for dipping. By an ingenious arrangement some of the closely packed stems are forced forward, so as to stand out from the mass (otherwise when dipped the compact mass would stick together), and are dipped in a solution of chlorate of potash, sulphate of arsenic, potash bichloride, powdered gypsum and gum arabic. About 6lbs. of the mixture go to 7,000 boxes of 80 matches each. The ingredients are cheap. Chlorate of potash costs 4 annas per lb., sulphate of arsenic 8 annas per lb., and potash bichlorate 6 annas. The dipped matches are put in a drying frame; and the remainder in the screw frame go through a similar process.—(*Timber Trades Journal.*)

TREE CULTURE BY STREAMS AND RESERVOIRS—AFFORESTATION IN WATER WORKS AREAS.

It would be superfluous to give instances of the destruction of forests causing the gradual drying up of springs and streams, and consequent widespread barrenness. The covering of the catchment areas with forest growth diminishes the quantity of silt brought down by the heavy falls of rain, and the roots of the trees having rendered the soil open and porous, the surface flow would be retarded at the time, and the flow into them would continue long after the rains had ceased. Forests exercise a most powerful influence on the consolidation of the soil and the maintenance of earth and rocks on the slopes of the hills. They act both by the trunks and the roots of the trees.

The action of trees in preventing landslips is twofold. Large quantities of water are annually lost from the reservoirs of the country by evaporation, caused by the barren and hot surface of the land surrounding the reservoirs. The planting of trees will certainly be to diminish evaporation ; many clouds charged with vapour would be attracted by the coolness about the trees, and the result would most probably be a deposit of rain.

Many illustrations can be given from the evil effects of a barren and dry surface of land surrounding several of our reservoirs. It has been asserted, and theoretically the contention is doubtless correct, that masses of woodland increase the rainfall. The causes of this result are sought for in the reduction of temperature associated with forests, and in the greater absolute and relative humidity of the air in woods. Trees do, however, under certain conditions of the atmosphere, condense dew on their leaves and branches, and this effect may often be seen in the wet state of the ground underneath trees on a foggy morning, when the surface elsewhere is comparatively dry.

In a district of heavy annual rainfall a smaller proportion of the precipitations is caught and evaporated from the trees than where the rainfall is light.

Similarly in the case of heavy and long continued rain, as contrasted with gentle showers ; in the latter case, in fact, but

little of the water reaches the ground through the leafy canopy of a dense forest. Then again much depends on the kind of tree, evergreens intercepting more water throughout a year than deciduous trees and a larger proportion of the rainfall is evaporated from the leaves and branches in summer than in winter.

Where water supply for domestic purposes is concerned, the avoidance of violent freshets on the one hand, and scanty flow on the other, is alike desirable.

The water of a reservoir surrounded by well-stocked woodland is not subjected to the same amount of violent agitation during gales as is the case when such sheltering agency is absent.

To the credit of forests is also to be placed the fact that they exercise a purifying influence both on the air and on the soil, germs of all kinds being markedly scarcer in a well-wooded district than in a similar extent of treeless country.

Afforestation in Water Works Areas.—This is a very important question to all Corporations and Water Boards, more specially in tropical countries. Valuable work has already been undertaken by many of our public bodies in the British Isles, the most advanced being the Corporation of Liverpool in connection with their water supply from Lake Vyrnwy, in Wales. The work of afforestation, over the whole of the catchment area, is being carried out in a most thorough and systematic manner.

Many other Municipalities, during the past few years, have also had similar schemes placed before them. It is, therefore, very desirable to draw the attention of all Municipal bodies, to the advantages and profits to be derived from planting their catchment areas with trees which ultimately will not only contribute materially to the retention of the rain that falls over the area, and thus assist in regulating the water supply in preventing floods and water famines, but will tend to the purification of the water and should also, properly managed, yield a fair and regular income on the capital expended. I am of opinion that this is a direction in which a considerable amount of afforestation may usefully be done. To prevent all risk of contamination of the water supply, it is the policy to *remove all human habitations, as well as live stock,* from

such areas. These areas, therefore, however well suited they may otherwise be for the production of crops or maintenance of live stock, are practically abandoned, and yield no return, beyond that obtained from sale of the water, upon what is usually a very heavy capital expenditure on the part of the Corporation. Such catchment areas, if they are to be thus utilised, should be placed under the control of a competent and experienced person.

Such areas must be planted with a mixture of timber-producing trees for permanent and secondary crops ; the secondary crop to be gradually cut out whenever the trees become suitable for agricultural or other industrial purposes.

Over the area, every second row, where possible, can be planted with quick-growing species of trees which will necessitate a commencement of thinning out.

Government cannot too strongly impress upon every Municipal body the great importance attached, to this question, in the preservation and purification of their water supply.—*(By Arborist, in the Tropical Agriculturist.)*

TIMBER RESOURCES OF MEXICO.

A special agent of the American Government states, in a report on Mexico, according to the latest issue of *Commercial Intelligence*, that the area of first class timber in the country is estimated at from 20,000,000 to 25,000,000 acres. The heaviest stumpages of pine and oak are found in the States of Chihuahua, Durango, Jalisco, Michoacan, and Guerrero.

The white and red oaks of Mexico comprise six species, including the " roble " oak, a very superior grade, which is claimed to have no peer as regards finish. As evidence of the indestructible character of hardwoods, he is informed that oak posts after a period of thirty years' standing in the ground show a comparatively sound texture, and that railway ties employed in the higher altitudes remain good without treatment for from ten to twenty years. There are also six species of Mexican pine, these comprising white sugar and bastard white pine, white and red fir, and a small percentage of yellow. The large percentage of clear or factory stock

found in the timbers renders these varieties especially desirable for sash and door purposes.

There are also in Mexico some 25 varieties of hardwoods not known to the lumber markets of the world, some of which, it is stated, might be easily classed with other precious hardwoods. Mexico's mahogany and cedar rating is already well established in New York markets. The largest bodies of these fine timbers or tropical hardwoods, are to be found in the Gulf States, or, more definitely, on the Gulf of Mexico, side of the Isthmus of Tehuantepec, in the States of Vera Cruz and Tabasco.—(*Timber Trades Journal.*)

THE AIMS AND FUTURE OF FOREST RESEARCH IN INDIA.*

BY E. P. STEBBING, I.F.S., F.L.S., F.Z.S., F.E.S.

The Foresters' profession entails constant research. The mere performance of his duties results in constant additions, both economic and scientific, to the realm of knowledge and the past has shown, as the future will show again and again in all countries where the science of Forestry is practised, that a Forest Service in a country is a vast machine working on two main lines, which may be roughly distinguished from each other. Firstly, the Forest Service of a State works entirely in the interests of the people: for their present comfort and welfare, for the comfort and welfare of future populations as yet unborn and for the enhanced prosperity of the State, which latter is directly dependent upon the prosperity, happiness and steady increase in numbers of its population. The lines upon which such work is carried out are well known. It embraces the preservation of the headwaters of the great rivers, of springs, streams, etc., the preservation of mountain slopes to prevent denudation and the covering up of cultivated tracts; the preservation from destruction of great engineering works such as roads, railways, canals, etc., by careful and scientific

* This paper was read by Mr. Stebbing at the Conference of Punjab Forest Officers at Lahore in January 1908.

reboisement; the provision of the wants of the people in fuel, grazing and necessary building materials, etc.; the provision of the large timber required by railways and engineering work of all grades in the country, all of which are more or less dependent upon wood; the opening out of the forest tracts by road works, the preservation of the game of the country, and finally the building up of a fine forest estate on areas which would otherwise relapse into waste jungle and prove useless to State and populace alike—these are some of the duties of a Forest Service to the State.

Our second main line of work is intimately bound up with the first, more intimately I venture to think than Forest Officers often suppose. It lies in the economic and scientific problems which daily confront the Forester. There is not one of us here to-day who in the ordinary course of his professional duties has not, at one time or another, been confronted with some economic question which he has more or less felt certain might be well worth taking up and investigating, with some problem in sylviculture or natural history which has presented new and perhaps fascinating aspects and which was, more than probably, unknown to the scientific Forester. Problems of both natures are of necessity the common experiences of a life which is led in the wilder regions of the earth or, shall we say, in regions where nature has a more untrammelled sway than is the case in the cultivated tracts of a country. But what has been the general fate of the numerous problems, many of the highest interest and value, which have confronted officers of the Department in India during the past half century. Where is the forest literature recording the observations made and the economic results attained as a result of such observations; where are the scientific records of such results—records which ever find such a warm acclaim from professional confrères and scientists throughout the world. We all know that such records do not exist, that our literature has yet to be built up, and that all the observations made by men, and brilliant men, who have passed before us, up through the ranks of the Department, have to be recorded afresh—the work has to be all done again.

In my own particular branch of Forest Research—Zoology—I have found myself recording observations of attacks and describing species of insects which I have subsequently discovered were known to Forest Officers some 20 years before I came to the country. And yet my observations on the life histories were the first to be published and the insects themselves were unknown to science. Now this state of affairs is not peculiar to Forest Zoology alone in India. The same condition of things exists at the present moment in every branch of Forest Research. It is not that those men who have gone before us did not observe. A man to be a good Forest Officer at all *must be an observer. And the Department* has had some excellent Foresters. It is that they did not for the most part record what they observed. Think what 20 years of Forest Records would mean to us all had the observations made during the last two decades been committed to paper.

I.—DEFINITION OF FOREST RESEARCH.

And this brings me to my definition of Forest Research. The term applies to work done in every branch of what may be termed the Forest Sciences; and these sciences embrace a wide field covering a study of the whole of the animate life of the forest in the Vegetable and Animal Kingdoms, from two points of view—firstly with the object of utilising it to the full for man's, that is the Forester's, purposes and, secondly, with the object of preventing the noxious forms of life from committing the damage peculiar to them. A study of the Mineral Kingdom must be included as it becomes necessary to consider the different consistency of the soils and the formation of the earth's crust in forest tracts with especial reference to the nature of the species with which our various forests are to be formed.

II.—DIVISION OF FOREST RESEARCH.

(a) Imperial Research by Government of India Officers.—It has generally been considered in India that the initiation of and provision for Forest Research, it might be said for research of all kinds, was the work of the Government of India, and that Local

Governments, Conservators and Divisional Officers could not be expected to find time for work of this nature; that this has been the opinion held in the past, rightly or wrongly, is well borne out by the literature available on Research subjects.

But is this view of the position the correct one at the present day?

The Government of India have taken the initiative, and I am sure that every one here will be willing to subscribe the warmest approbation to the brain that evolved the Imperial Forest Research Institute at Dehra Dun. It has yet to justify its existence, we admit, but there is little danger of it failing to do so in the near future. So that Forest Research from an Imperial point of view has made a commencement, although it is scarcely more than a seedling at present.

(b) Provincial Research by Provincial Officers attached to a Provincial Research Office.—But is this enough? Will the ranks of the Service be content to leave the whole burden of Forest Research to a handful of officers appointed from the Department by the Government of India? If the answer is 'yes,' then Forest Research will progress at a very slow rate and the Department will have to wait years to see—to make use of—results which, with a greater co-operation, could become available to all and prove of daily utility in a very short period. But I am one of those who believe that the reply will be 'no.' In addition to our Imperial Central Research Institute we require Provincial Research Institutes with one or two whole-time officers working at their own Provincial problems. Such officers would find the whole of the Imperial Central Institute at their backs with ever ready help and they would be able to carry out for their Provinces research work which, without such a provincial centre, might have to await its turn with other Provinces for several years before the Government of India men could take it up. The Provincial Research centres could originate with quite small beginnings, but it would not be long before their great value would strikingly demonstrate itself and, under the fostering care of energetic Conservators, their inauguration would lead to an immense amount of Provincial

Research work being got through. And it must be remembered that such work is not advocated in the interests of Science alone. It admits of no cavil that Research work in the Forest Department in India is intimately bound up with the financial value derivable from the forests. Research will show, and show unerringly, how this value may be increased many fold.

III.—FORESTRY SUBJECTS IN WHICH RESEARCH WORK IS REQUIRED.

We have touched above on the subjects in which Research work is required. They will suggest themselves to any Forest Officer who has considered such questions. The sylviculture of the Indian trees remains almost a sealed book to us. What do we know about even the commonest, most abundant and most valuable, *e.g.*, Teak, Sal, Deodar, Blue Pine? Is there one amongst us who would undertake to write a sylvicultural monograph on any one of these? I think not. And yet we frame working-plans, it is absolutely essential that we should prepare working-plans, for forests all over the country—forests filled with species of trees of whose sylvicultural requirements we know little and about the life histories of whose pests we know, if possible, even less. And yet we are all professional Foresters trained to observe and to note. Since our seniors have not left us a legacy of forest literature, it is surely our duty to set to work in order that our successors may not find themselves in the same position. The Botany of our forests is better known, but although Foresters eminent in the science have aided in this and done much, the Department as a whole cannot with any justice take to itself a very great amount of praise due for its satisfactory position in this respect. Mycology or the study of the fungus diseases of trees is an unknown field in which the worker will find a magnificent return for his labour. That this field has been left fallow by Forest Officers is one of the insoluble mysteries the Department presents. The Chemistry of the forest soils again! What is known about it? How many plantations have come to nought, how many experiments have been made in areas where, had we known anything about the nature of the soil we were intending to plant up, we should have

chosen very different species or perhaps left the place untouched. What the Chemist can do towards pointing out the value of many a minor product in the Forest is at present another unexplored field, but one is far from being over optimistic when one states that in the hand of the Forest Chemist will be found a key which will unfasten a lock of gold giving access to a treasure chamber. A forest memoir to be shortly published will show the utility of the Forest Chemist. The Zoology of our forests, more especially the entomological portion of the subject, is but little known; it is almost certain that our immunity from serious attacks of insect pests has been solely due to the fact that the major portion of our forest tracts consist of natural mixed forests, which is the type most resistant to attacks of this nature. Things will become very different as our forests become more and more under control and are subject to more intense management.

Finally, there is the branch of economic products. This covers a vast field and touches intimately on all the other branches of forest science, for it demands their aid in helping its own work. The minor products of such extensive forests as India possesses, covering so vast an area and situated in such varying conditions of climate are necessarily numerous. We know, from an economic utilitarian point of view but a few of them. Even the economic uses of our timbers, that first product of the forest, are unknown for the most part to us. And if to us, how can we expect to place them upon the market? Sal, Teak and Deodar are not the only timbers in India, and yet where is the contractor who will take anything else if he can get these. And yet we probably possess timbers which would serve his purpose equally well and which we could let him have at a cheaper rate. But we do not ourselves know their qualities and cannot therefore push them.

As many of you know the Government of India Economic Officer of the Imperial Forest Research Institute has commenced work in this field, and already there is an indication that his work is going to meet with unqualified success, and success to the economic man, I need not remind you, means increase in the forest revenue. Does it not seem probable that the Conservator

who persuades his Local Government to initiate a small Provincial Research Institute and to put on an economic product member will find that he has gained a right hand man, whose great utility he will very soon financially realise.

IV.—THE AIMS OF FOREST RESEARCH.

What are the aims Forest Research sets before itself? We have already briefly alluded to them and will now proceed to do so at greater length under the three sections (A) Forest Aims, (B) Economic Aims, and (C) Scientific Aims.

(A.)—FORESTS AIMS.

The aim at the back of all the Forester's work is the improvement of his crop. In effecting this he may not be guided solely by Nature's laws in this respect, as he has to consider at the same time utilitarian questions which necessitate his growing on a given area the maximum number of trees the area can be made to support. At the same time even with this proviso to be borne in mind the improvement of his crop is his chief object. And to effect this the Forester requires to make himself acquainted with a vast number of points having a direct relation to the growth and well-being of the particular species he is making use of. Even if literature is available this necessitates a great deal of research in the library. But when the literature is not available, what then? The research has to be conducted in the forest on the ground and entails years of patient observation and continuous and consecutive recorded observation before the officer can say that he is doing the right thing by his trees. This is the point at which we still are in India. We have been years watching the few important species for which we have had a market, *without* keeping those records which would have given us and our successors a foundation upon which we could have hoped to have been now treating our species according to their sylvicultural requirements. Surely the time has now arrived for each one of us to commence recording and recording in such a manner that our records will be available to the Department as a whole. To put down observations in

obscure divisional journals or in annual reports is, as we all by now know full well, merely to render then unavailable for general reference.

(B.)—ECONOMIC AIMS.

1. *Study of Substances of Economic Value in the Forest with a view to the Improvement of the Outturn.*

A study of the substances of economic value in the forest naturally divides itself into two heads :—

(*a*) Those useful to the people.
(*b*) Those of commercial value.

(*a*) Economic Substances of Use to the People.

The number of such substances is a large one and a great deal of detailed research into their properties and abundance is required. To enumerate but two—fodder grasses and edible roots and fruits. In a period of famine such as has now overtaken parts of India the value and importance these products acquire is tremendous. Can we say that we know the best fodder grasses to encourage in fodder reserves or that we are acquainted with the numerous edible roots and fruits of our forests. Have we yet a Forest Famine hand manual to which a Divisional Officer could turn when famine overtakes his district? Research will in time give us one or, preferably, we will hope that provincial hand manuals of this nature may be written whose utility none will gainsay. It would be easy to multiply instances of what economic research in the great forest estate in India can and will do for the benefit of the people—but the above two are, perhaps, sufficiently typical.

(*b*) Economic Articles of Commercial Value.

There is no occasion to dwell upon this side of the economic work to be done. Certainly in no other direction of Forest Research are the resultant financial returns so intimately dependent upon the success of the results achieved. It is not too much to say that the field opening out in this branch is of almost incalculable extent and of the highest pecuniary value. The investigations range from a study of the properties of all the principal

species of timber trees in the forests, to a determination of species which will prove valuable as veneers to the properties of the oils the woods contain, to those in the bark and seeds, to tannins and gums and their marketable supply. Seeds and fruits such as *Mallotus* and myrabolans, etc.; grasses such as the *bhabar* used in paper-making; soft woods utilisable in the manufacture of paper pulp, matches, toys, etc.; bamboos used for paper pulp, umbrella handles and sticks; canes and fibres. Other products requiring investigation and study are the valuable lac, of which no less a sum than 3¼ crores of rupees value were exported from India during 1905-06; honey and wax and cocoons, whose study and introduction will yet, with other minor products, turn many a non-paying forest division into a revenue-paying one.

The mere enumeration of a few of the enquiries awaiting economic research will show how illusory is the hope that one or even several Imperial Officers of the Central Research Institute could hope to help substantially the several Local Governments to solve problems, whose early solution is financially imperative, in anything under a long period of years. Whilst for him or them there are general economic problems in which work will yield results of utility to the country as a whole, each Province has burning questions of its own which could be best tackled by a Provincial Research Officer.

2. *The Study of Pests.*

The pests of the Forester fall into two great groups coming respectively under the Vegetable Kingdom (the fungi) and Animal Kingdom (animal pests).

(a) Fungi.—There is little to be said under this head at present. The research work accomplished is comprised in a few scattered papers on some deodar-fungi, a casuarina pest and that enigma of science the disease known as 'spike' on the sandal-wood tree. Truly a poor state of affairs! A mycologist is a crying need of the department and there is, I believe, every hope of an Imperial man being appointed. But this is not enough, and to officers of a Province like the Punjab with valuable coniferous

forests *I would say that every little they can do to make a beginning* in this important branch of Forest Science will be of immense value.

Zoological pests.—It does not fall within the province of this paper to deal with a consideration of the investigations which are being conducted into this branch of research. The expert study of Forest Zoology had the first start in India and, with some seven years at the back of it, it may have got furthest ahead, but still an immense field stretches before its workers and I would wish to take advantage of the presence here of some good workers in this line to thank them all and all brother officers for the unwearying aid that has ever been vouchsafed me in my investigations.

It has been said—often said—that little can be done to counteract serious attacks of pests in India. I would say wait! *Until we know the life history of* a pest, it is quite impossible to say at what point it can be best attacked. We are at present becoming acquainted with these life histories and I say, and say without any desire to be considered an alarmist or unduly pessimistic, that the day will come when a Divisional Officer will, in his great need, make use of those life histories. It is impossible to go on improving our crops and, perhaps worse still, continuing to plant pure crops and expect that insect invasion will never worry us. What Continental Foresters have to deal with, what American Foresters have had to face, that we ourselves shall encounter sooner or later. Research will render us prepared.

V.—THE FUTURE OF FOREST RESEARCH IN INDIA.

Perhaps in no other country in the world does there exist such vast possibilities before Forest Research as in the case in India, and the reason is to be found in the peculiar economic conditions of the country. We have forests of every degree from the moist damp vegetation of the Tropics to the fine coniferous forest of the great Himalayan Chain and every intermediate region of vegetation exists in the country. This in itself would render the problems of Forest Research of the very highest scientific

value to any country. In India we have other conditions which render them not only of scientific interest but of direct vital economic value to the future welfare of the country itself. For India has an enormous population, a population which in the future, as railways increase and open out the country, as sanitary science spreads amongst the people, will densely populate areas at present uninhabited. The demands of this future population on the forests will be far beyond the dreams of the present forest Officer, and yet it is he who is responsible that when this demand comes the forests shall be in such a condition as to be able to supply it.

The Research Institute and Research Officers have been called into being and it rests with them, each in his several line, to point out the directions in which experience shows that improvement is required, the directions in which observations, connected series of observations, must be made; to place on record every investigation made by them that can be utilised by the Divisional Officer. But the Research Officer requires help if research is to make real progress. He requires help from his confrères in the executive line; not only help when he happens to be in their divisions, but sustained help at all times; and the best way the Executive Officer can aid the Research Officer, and I speak with seven years' experience, is to send him every note, every observation made in his particular branch whilst on duty in the forest. It is the observations made in this way that it is so absolutely necessary to have placed on record and which are of such incalculable importance in research. The recorder of the note may not consider it to have any very considerable importance but the Research Officer, with his wider experience, may at once see its value, as forming the connecting link in a chain of reasoning or deduction in certain investigations he is making. This is the manner in which the Executive Officer can aid true Research and the means by which it will be immensely furthered in the future.

The other way I have already touched upon. I would ask the Conservator present here to-day to let us have his views on the question of the formation of Provincial Research Institutes.

I would not be understood to advocate large buildings or a large outlay of money on apparatus, etc., for such centres. I would suggest quite small beginnings. One officer appointed to tackle the most pressing of the Provincial Forest Research questions of the day would do much, and that officer would probably never go back to executive work or at any rate the post once inaugurated would never lapse, for if forest research has one quality it is that it is a sticker. We have now our Provincial Forest Schools or classes for the instruction of the lower subordinate ranks. It might be possible to place an Imperial Officer in charge of the school or class, his spare time being devoted to research work. Once commenced its utility becomes so evident, even to the non-forest-trained man that all wonder why the work was not taken up long years before.

I believe myself that the future will show us not only a Central Imperial Forest Research Institute, and Institute of such dimensions that it will be a mature man compared to the present infant-in-arms. But I think the future will show us more. It will show us a Provincial Forest Research Institute in every Province and those Provincial Institutes, no matter what the strength of their staff may be, will be paid for entirely from the surplus revenue which will be the direct result of their formation.

We were asked by a high official the other day what we thought of the prospects of Forest Research in India. I replied that I was firmly of the opinion that a field lay before us in India of such an extent as to be beyond the wildest dreams of the European or American Forest Officer, and that the Research work to be done in India would rank amongst some of the highest scientific work accomplished during the present century. Such is my belief.

ORIGINAL ARTICLES.

THE REGULAR METHOD OF TREATMENT AS APPLIED TO THE FORESTS AROUND DARJEELING.

As a belief, that extensive tracts of forest in India will have to be managed under the regular method, appears to be gaining ground, the following account of the application of this method to the Darjeeling forests may be of interest to some of your readers. Although these forests are in many respects peculiar, few of the difficulties which have been met with in attempting to manage them under this method are of an exceptional nature, and it may be useful to Foresters who are attempting to apply the method or any adoption of it to other forests to learn how far it has succeeded or failed in this instance.

GENERAL DESCRIPTION.

The total area of the Darjeeling forests is 24,736 acres, and they occupy the crests and upper slopes of three main ridges which meet at their highest point, Senchal hill, 8,600 feet in elevation. The lower boundary is usually 5,000 to 5,500 feet in elevation. The slopes are moderate to steep, averaging 30° or slightly over, and they are generally covered to a great depth with a loose soil which has resulted from the decomposition of the underlying gneissic rock.

The average yearly rainfall varies from about 100 inches in the driest to 150 inches in the wettest localities. The winter months, November to March, are dry and comparatively mild, heavy snow-fall or severe frost being very rare. The spring months, April to the middle of June, are comparatively damp and cool, and rain and mists usually predominate from about the middle of June till late in October.

The forests are mainly required for the supply of Darjeeling, with its neighbouring cantonments, and of Kurseong with timber, firewood and charcoal. But they have also to meet considerable

demands for box-planking and engine fuel from tea gardens which lie below them. Grazing has to be found in them for up to 842 head of milch cattle for which 12,630 acres must be kept open, and the greater part of the supply of fodder required for horses and draught cattle kept in and round about Darjeeling is obtained from them. Apart from their use for such supplies, their maintenance may be said to be necessary for the prevention of erosion and the preservation of the numerous springs which take their rise in them.

The forests are traversed by three cart-roads by which the lead from them to Darjeeling varies from 5 to 14 miles. The lead from the forests to these cart-roads ranges up to 4 miles.

The flora is very varied, and it is unnecessary to attempt to mention more than a few of the most distinctive kinds of trees, *i.e.* :—

(*a*) The most valuable or principal species, yielding the best kinds of timber obtainable locally—Magnolia (*Michelia excelsa* and others); chestnut (*Castanopsis Hystrix*); oaks (*Quercus spp.*, principally *lamellosa*); and *pipli* (*Bucklandia populnea*); walnut (*Juglans regia*) and *tun* (*Cedrela spp.*); but the three last named are now very rare.

(*b*) Secondary species, yielding fairly good building timber or box-planking, such as—Laurels (numerous genera and species of which *Machilus Gammieana* and *M. edulis* are the most important); maples, (*Acer spp.*, principally *Campbellii*); *maya* (*Eriobotrya petiolata*); plum (*Prunus nepalensis*) and *chilauni* (*Nyssa sessiliflora*).

(*c*) Inferior, mostly soft wooded species, some of which yield fairly good box-planking or are used in rough buildings, such as—*Gobria* (*Echinocarpus dasycarpus*); *dab-dabi* (*Meliosma Wallichii*); alder (*Alnus nepalensis*; a few laurels; *mallata* (*Macarangua spp.*); *jhingni* (*Eurya spp.*); *kanakpa* (*Evodia fraxinifolia*); and *kharani* (*Symplocos spp.*), the three last named being usually of small sizes.

There is only one indigenous conifer (*Podocarpas neriifolia*) which is at present only represented by one small group of trees. But *Cryptomeria japonica* has been naturalised, and a similar remark applies to *Cupressus funebris*. Various other exotics such as deodar, silver fir, ash, Australian *acacias* and blue gum have been unsuccessfully tried.

All kinds of trees are removed for firewood from the more accessible localities or are made into charcoal in other parts of the forests. The best fuel woods are however oaks, *maya, jhingni* and *pipli*, the next best being maples, chestnut, plum and laurels.

PAST HISTORY.

Before its annexation, in 1850, the district was almost uninhabited, and except for small areas which had been jhumed the forests were untouched. During the early days of Darjeeling the demand appears to have been almost entirely met from land which it was sought to clear for tea or other cultivation. These forests were placed under the management of the Forest Department in 1864, and for about the next ten years, cutting appears to have been restricted to the most accessible parts which were practically clear felled. From about 1874 efforts were made to secure a better distribution of fellings over the whole area and to plant up the clear felled patches, and though the attempted regulation of fellings appears to have in the first instance resulted in the cutting out of the best specimens of the principal species, wherever found, it in the end, after prolonged discussion, led up to the preparation of the first (Mr. Manson's) working-plan and its application from the beginning of 1892-93. Under this plan the forests, with the exception of six plots, 2,835 acres, which occupied the crests of main ridges and were reserved for selection working, were brought under the regular method, or under a conversion to that method. The adoption of this method, rather than the selection method, appears to have been mainly due to the well ascertained fact that grazing practically prevented reproduction of the principal and of many of the secondary species in parts of the forests open to the practice. But there was also reason to believe that most of these trees give better results in a regular than in an

irregular crop. Coppice or coppice under standards was out of question as it must have resulted in the extermination of the valuable species.

The area (21,901 acres) brought under the regular method was divided into seven working-circles to each of which the same treatment was applied. This included the adoption of a rotation of 160 years which was divided into five periods of 32 years each, corresponding with a division of the circle into five periodic Blocks, I to V, of about equal size. It was arranged that Block I should be regenerated in the first period (1892-93 to 1923-24) and that the other Blocks, II to V, should be subjected to improvement fellings. The coupe in Block I was limited to half the existing crop on a sixteenth part of its well-stocked area, that is to say, regeneration was to be accomplished by two fellings, a first or seed felling and a final felling of equal intensity. But the location of coupes was left to the Divisional Officer, and though it was apparently supposed that an interval of 16 years between the seed and final fellings would everywhere answer requirements, no such interval was actually prescribed. As it was believed that the natural reproduction of the principal species would not be everywhere sufficient, provision was made for helping such reproduction by plantations, and it was also provided that poorly stocked parts of Block I should be planted.

The yield of improvement fellings in Blocks II to V was fixed by volume, *i.e.*, at 30 cubic feet per acre of well-stocked area per annum, the length of the felling rotation adopted being four years; and the yield of the selection fellings in the areas to which the latter method was applied was similarly limited.

It may be added that in every block areas containing few or no large trees were described as poorly stocked, whether they carried promising young growth or not; also that every Block I and the selection-worked areas were closed to grazing, but no particular rule appears to have been followed in selecting other parts of the forests for closure.

Except for unimportant deviations, the provisions of Mr. Manson's plan were duly carried out for ten years, ending with

1901-02. Coupes were formed in the well-stocked parts of Block I by dividing them into equal portions, situated in a regular succession on the ground, and seed fellings, consisting of the removal of half the crop, were carried out in ten of these coups, *i.e.*, in $\frac{10}{18}$th of the well-stocked area of Block I, each coupe being planted up throughout with transplants of the principal and secondary species, at a rate of 200 to 300 transplants to the acre; and suitable proportions of the poorly stocked areas of Block I were similarly planted. Improvement fellings were also carried out in Blocks II to V, but they appear to have in many cases borne more heavily on sound trees of the principal species than they should have done.

By the end of 1901-02 final fellings appeared to be urgent in the oldest coupes, *i.e.*, those in which such fellings had been made ten years ago, and a revised working-plan was prepared, by Mr. Osmaston, to provide for final fellings in the first ten coupes in the ten years 1902-03 to 1911-12. In other respects this second plan carried out the provisions of Mr. Manson's plan with the exceptions that the Divisional Officer was given practically a free hand in respect of fellings in the poorly stocked areas of Block I and throughout Block V to promote regeneration, natural or artificial; and the necessity of restricting improvement fellings in Blocks II to IV to the removal of dead and very unsound trees was emphasised. Every Block V which had previously been open was closed to grazing. As the first plantations in the coupes of Block I had been only moderately successful, and as natural reproduction of the principal and many of the secondary species appeared to have been satisfactory in limited areas only, replanting after the final fellings was prescribed. This plan has been closely followed up to date.

RESULTS OF PAST MANAGEMENT.

In describing the results of the past management it is convenient to give first place to well-stocked areas in which only selection or improvement fellings have so far been attempted. These generally carry an open or interrupted crop of old or very old trees,

including a fair proportion of oaks and chestnut, which are for the most part more or less unsound, magnolia being comparatively rare. Most of the trees are of secondary or inferior species, and nearly all of the trees which are comparatively young and vigorous are of inferior species. This crop is usually at its densest along the crests of ridges and most open along ravines or depressions.

The condition of the advance growth or undergrowth appears to depend mainly on the extent of the grazing. In the most heavily grazed areas, when the crop is open, there is little besides a poor kind of turf which is in many places being invaded by *Viburnum* or other inferior shrubs which are not eaten by cattle. Where the canopy is more complete the undergrowth mainly consists of ferns and other herbaceous plants, with small patches of *Viburnum* and *kharani* here and there.

In less heavily grazed areas turf is very rare and the advance growth of *kharani* and other inferior species of trees is much more dense, often including a small proportion of secondary species such as maples and laurels and occasional oak or chestnut saplings. But this advance growth rarely extends into pronounced depressions, which are for the most part occupied by brambles and other weeds. But in a few blocks *kibu* (*Strobilanthes*) forms a dense undergrowth which almost prevents reproduction of any of the trees, whilst at some of the highest points the *maling* bamboo (*Arundinaria racemosa*) is fairly abundant. The latter is however kept down by the fodder cutters. In blocks which have been closed to grazing for any length of time the advance growth is generally denser than in the lightly grazed blocks, tending to spread into the depressions, and contains a much larger proportion of principal and secondary species, the former being generally represented by oak and chestnut, though magnolia is abundant in a few places.

In areas which were planted, generally after clear-felling before the preparation of the first working-plan, results are generally poor. These plantations are for the most part completely stocked with a young growth which mainly consists of inferior or of inferior and secondary species, the principal species being represented by

branched and unpromising oaks, magnolia and *pipli*, and by suppressed, but more promising saplings or poles of these species. In a few places where *pipli* has been planted pure nearly all the trees are branched and defective.

In the coupes of Block I in which final fellings have been carried out, there is usually a dense or fairly dense crop of seedlings, saplings or small poles on the ridges and convex folds of the slopes, but except for scattered transplants, which were put out after the final fellings, the depressions or concave folds contain little besides weeds, brambles and the like. On the former the crop mainly consists of self-sown inferior or secondary species such as *kharani*, *kanakpa*, *dab-dabi*, maples, laurels and *maya* which established themselves before or after the final felling. But in the few places when the natural reproduction of principal species, such as oaks and magnolia, has been good it includes ample proportions of the latter which are elsewhere only represented by surviving transplants, numbering 50 to 200 to the acre from the first and second planting, or from the second planting only. This supply ought to prove sufficient; but allowing for the many risks to which such transplants are subject, and the unfavourable conditions in which many of the older transplants have been left after the final fellings, the ultimate formation of a crop of mainly consisting of well grown trees of the principal species cannot be presumed.

Badly stocked depressions comprise on the average about a quarter of the area of each coupe; but in some coupes they are hardly noticeable, whilst in others they include half or more than half of the total area. The main cause of the ill-success of their regeneration has probably been excessive dampness with its accompanying profuse growth of weeds; but damage caused by the fall of trees in the final fellings, when most of the trees which were cut found their way into these areas, has materially helped to bring about the present state of affairs. It is now sought to plant up such areas after the final fellings with robust species, such as walnut and alder. Though earlier attempts to plant walnut failed, its winter transplanting, which was introduced by Mr. Osmaston in 1902—04, has recently been remarkably successful.

Plantations in poorly stocked areas of Block I have for the most part been made in places where the ground was moderately or well covered with small trees of inferior species and have been on the whole very successful. The kind of shade afforded by the crop of inferior species appears to have satisfied the requirements of transplants of the most exacting kinds of trees, such as *pipli* and oak, and as the latter have developed into saplings and poles, they have, with the help of the inferior species, rapidly formed a most satisfactory kind of canopy, which only requires a careful and progressive thinning out of the inferior species. Small parts of these poorly stocked areas, where the soil or other conditions were considered unfavourable for the principal, species have been planted with *Cryptomeria* which, when grown in dense enough groups, may be expected to produce timber of considerable value. But the question of using cypress instead of *Cryptomeria* in places which appear suitable for either or both of these species is under consideration.

GENERAL CONCLUSIONS.

The general scheme of management which was introduced by Mr. Manson's plan has successfully stood the test of a sixteen years' trial. The rotation, 160 years, is excessive from some points of view, but on account of the grazing rules and the limited demand it cannot at present be conveniently reduced ; and the selection of what are at present the most important Blocks, *i.e.*, I and V, cannot be improved on.

There is, however, considerable room for improvement in the method of carrying out the regeneration fellings. Though Mr. Manson's plan is not responsible for the division of Block I into coupes on the mechanical sort of plan which was adopted, the attempt to regenerate these coupes by cutting out half of the crop throughout their areas in the first felling, and removing the remainder of this crop in a final felling, taking place at a fixed interval after the first felling, was in accordance with its provisions. This method has made Divisional Officers in a large measure irresponsible for results. It has not particularly favoured reproduction of the inferior or secondary species as the establishment

of the latter in sufficient numbers to form a complete canopy has largely depended on the reproduction of light demanding trees, such as maples, *kanakpa*, *dab-dabi*, etc., after the final fellings; and it has only on very small areas resulted in the natural reproduction of principal species to any marked extent. First plantations of the latter, which were carried out after the seed fellings, have been for the most part unsuccessful for the reasons that many of the transplants died out before the final fellings and of the survivors many were destroyed in the course of these fellings, whilst others have suffered from their sudden isolation. From first to last, plantation works in the first ten coupes of Block I will involve an expenditure of between Rs. 30 and Rs. 40 per acre of coupe, and about half of this expenditure has been almost wasted.

It is improbable that under any method of regulating regeneration fellings which may hereafter be introduced, the necessity of planting the principal species will be entirely removed. But it should be possible to devise means of regulating these fellings so as to secure better natural reproduction, and to avoid the waste of time and money which has resulted from felling unwieldy trees, which were reserved in the first fellings, on the top of the reproduction which established itself or was established between them and the final fellings. The most essential reform is that the seed felling, instead of being of equal intensity throughout every coupe, should be distributed with a view to rendering the places where reproduction is expected to result as far as possible safe from risks of damage by the subsequent fellings; and another almost equally desirable change is that the Divisional Officer should be allowed to use his discretion to a large extent in carrying out the subsequent felling or fellings.

Fortunately in most places, that is to say in places where the ridges and subsidiary ridges are well pronounced and numerous, the ground readily lends itself to such changes in method. The ridges are the parts on which reproduction, natural or artificial, establishes itself most readily and after all trees of unwieldy sizes which grow on them have been cut, reproduction which establishes itself on them runs little or no risk of damage from subsequent

fellings. When they have been regenerated, fellings can conveniently be made to proceed downwards from them, towards the depressions, where regeneration can be allowed to look after itself till the final fellings are made, when, failing the existence of sufficient advance growth, robust kinds of trees, such as walnut and alder, can be planted with a reasonable hope of success.

Where the configuration of the ground does not favour this treatment, it will generally be possible to arrange for group fellings which will have very similar results.

The intensity of the seed felling should depend on conditions. Where there is a well-established advance growth, or the supply of trees of moderate sizes is relatively large, a considerable part of the crop may with advantage be cut, whether the advance growth consists of inferior species only or not, for in the former event the advance growth will form a good nurse for the reproduction of more valuable species. Where there is little or no advance growth or the crop almost wholly consists of very large, old trees, a greater amount of caution will be desirable. But in matters of this kind and also to obtain information as to when and how the subsequent felling or fellings should be conducted, the only thing to be done is to experiment, and gain the necessary experience from the success or failure of these experiments.

I may add that most recent observations tend to prove that the conduct of regeneration fellings in the manner I have outlined may be made to lead to a plentiful natural reproduction of some of the principal species, such as magnolia, oaks and chestnut, on considerable areas. But, possibly, to secure results of this kind it will be necessary to give the Divisional Officer a much freer hand than he has so far possessed in selecting coupes for seed fellings. Anyhow the introduction of the changes I have described would necessitate the abandonment of the area check on the outturn in favour of a volume or stem check.

OUTTURN AND FINANCIAL RESULTS.

It may be of interest to add that the average yearly yield of the forests during the 15 years 1892-93 to 1906-07, which have

elapsed since the introduction of Mr. Manson's plan, has been, expressed in cubic feet solid—timber 117,020; fuel-wood 845,434; total 962,454, or 39 per acre per annum. But during the last five years of this period the total yield has averaged 1,140,358, or 46 cubic feet per acre per annum.

The financial results of management may be expressed as follows, a proportional share of the general charges of the Darjeeling Division having been allowed for :—

Period.	Average yearly figures.				
	Revenue.	Expenditure.	Surplus.	Gross revenue per acre.	Net revenue per acre.
	Rs.	Rs.	Rs.	Rs. a.	Rs. a.
Last 15 years ...	74,376	54,763	19,613	3 0	0 13
Last 5 years ...	94,709	50,135	44,574	3 13	1 13

The reduction in expenditure of recent years has been caused by decreases in departmental works which have now practically ceased.

Owing to the existence of these forests Darjeeling is so well placed for obtaining necessary supplies of forest produce that its market prices of the different kinds are comparatively low in spite of the fact that the cost of labour and transport is high. These market prices are annas 14 to Re. 1-6 or Re. 1-7 per cubic foot of sawn timber; annas 5 to annas 6-6 or annas 7 per maund of firewood; and Re. 1-2 to Re. 1-4 per maund of charcoal, according to quality and season. Prices obtained from purchasers for trees in the forests range between 20 and 40 per cent of these market prices.

DARJEELING: A. L. MCINTIRE, I.F.S.
28th June 1908.

A PLEA FOR SO CALLED "WORTHLESS SPECIES."

In many localities, and the Madras Presidency may be included in the category, there has been a run on certain species of trees, such as Teak, Blackwood, *Pterocarpus Marsupium* and *santalinus* and many others, so that frequently those species have disappeared altogether or have become very scarce and generally stunted in growth. This has in most cases been due to the forests having been for so long worked under the permit system which entirely ignores all economic working; but there have been also not infrequent cases in which the forests are supposed to have been worked economically, but yet nevertheless such species have still been felled whilst the commoner and less demanded species have been left in the forest, because it was deemed imperative to make revenue. The result is that in some places there is but little left other than what are considered "Worthless Species," because they have no marketable value; amongst such may be classed *Dalbergia paniculata*, *Sterculia*, *Cochlospermum*, *Givotia*, *Gyrocarpus*, the figs, and common white-wooded kinds which yield neither timber nor even respectable fuel. Because they are thus considered worthless, it has been suggested more than once that they cumber the ground, and take up space which might be utilised by valuable species; and that they should be therefore cut out, or, because that operation is too expensive, that they should be ringed, girdled, or mutilated in the cheapest way possible, that is capable of killing them out.

It seems to me that we should be exceedingly chary of adopting drastic measures of this sort; and that it is very probable that Nature has some very important functions for these species to perform. We find that Nature has endowed them with a power of reproduction considerably greater than is possessed by many of the more valuable species; for instance, in endeavours made to massacre and obliterate *Dalbergia paniculata* it has been found that it will pollard from the place where it has been girdled, it will produce abundant coppice shoots and even still more abundant sucker shoots when it has been cut down, and it produces a fairly copious regeneration of seedlings even in the most bare and arid places,

where but little else will come up; indeed it almost seems as if Nature had decreed that it shall not be extirpated, no matter how severely the brutal hand of man may be against it. The same applies, to a less extent perhaps, to the other species enumerated; wherever the forest has been greatly opened out, the progeny of these species reappears even if the parent tree has been cut out. Seemingly the only effectual way to get rid of them is to raise a very dense moist forest around them.

If then Nature insists upon them growing, in what way could they possibly be of utility? It seems to me that to this question there is one possible answer and two probable ones. During the past year or so, a good deal of prominence has been given to the fact that trees of a single species produce deleterious matter in the soil such as tends to prevent reproduction by seed of the same species; the recent experiments in America distinctly show that this old theory of upwards a century ago is not a fictitious obsolete one as many supposed, but a genuine *bonâ fide* fact. Is it not possible then that these inferior species may, perhaps, be the scavengers of the better species, consuming the excreta given out by the latter, and thereby purifying the soil again for the better species? With regard to *Dalbergia paniculata* it belongs to the family of *Leguminosæ*, an order that is characteristic for many of its members producing root-nodules that nitrogenise and fertilise the soil; have experiments ever been made to find out whether perchance this tree does not act in the same way? or have any experiments at any time been made to find out whether, and in what way, these trees may not affect either the soil or the air? If not, then this is a possible solution.

As regards their probable utility, in the first place their leaves and débris form soil. The majority of these species are found where the forest has been unduly opened out, mostly in places where the soil is very shallow and outcrops of rock are abundant, and by no means infrequently on sheets of bare rock; in fact they form a growth where few other trees can exist; and it seems to me that in such shallow soils no vegetation of any sort or description should be taken out, as one of the first things essential for the better species is to *make* deep soil.

The second way in which they seem to be useful, after the soil has attained a sufficient depth to produce the better species is by lengthening the bole of those better species. If teak, for instance, is grown right out in the open, its natural tendency is to branch out and form a short bole; it is often asserted that teak is by nature a light lover, and that therefore it should be freed from surrounding trees; this seems to require a qualification; as above stated its natural tendency is to branch low, but we require a long bole without branches, and we therefore insist upon an abnormal form and growth. Almost the whole of these so-called worthless species are exceedingly fast growers, very straight growers, have a *short life* and a *deciduous foliage*; their fast straight growth obstructs branch growth and draws up the stems of the better species; their deciduous foliage does not materially block out the light from the leading shoots,—and I take it that it is for the leading shoots essentially, not for the lateral ones that the light is required,—whilst their short life enables them to get out of the way when the later development of growth of the better species demands it.

There is another class of "worthless species" that seems to demand recognition, and this is of such evergreen shrubs and small trees as *Ixora*, *Canthium didymum*, *Memecylon*, *Strychnos*, *Atalantia*, *Glycosmis*, and numerous others, which grow in the plains and hill slopes of the dry districts, and form what Gamble calls the Deccan Dry Evergreen Forest. They never produce really good timber, but furnish a fair fuel; and ordinarily they form a somewhat large percentage of the exploited material in coppice under standard coupes, the standards almost invariably consisting of larger deciduous trees. It seems to me that they ought not to be felled, and that they have much more important functions to perform than the supply of a small quantity of fuel. An opened coupe is for several years much more liable to fires than one fully stocked, and if these evergreen species are cut out the chances of fire are much greater. Whilst they exist in the forest they keep the soil damp within a certain radius all round them even in the hot weather, because their evergreen cover prevents evaporation, and indeed it is more than probable that the hotter the weather, the more

moisture they give out into the air around them. Now the majority of the soils on which they grow—sandy, gravelly, or black cotton—are almost sterile, unless they contain moisture; but if they contain moisture they are fertile enough; wherefore the better species growing on such areas cannot be nourished in the hot weather if they are cut out, but can be nourished and developed *during the hot weather if they are kept as shelter to the ground.* There is one other point about them, and that is that their leaves and droppings, owing to there being so much more moisture under them, form a far nearer approach to humus than could ever be the case with the tinder-like leaves of deciduous species on the parched-up soil under them. Anything then that conduces towards the retention of moisture in the soil in these very dry climates tends to fertilise the soil, to improve the leaf mould, and to lessen the fires; and surely then these evergreen species instead of being considered worthless, because they have but little marketable value, should be considered as amongst the most valuable owing to their sylvicultural qualities; instead of being put amongst the unclassified trees, capable of being mutilated at will, should be put amongst the reserved classes, not permitted to be cut at all except under special permission.

9th July 1908. A. W. LUSHINGTON.

SOME PLANTATIONS IN THE SATARA DISTRICT OF THE CENTRAL CIRCLE OF BOMBAY.

1. Plantations in photos A, B, C, D, E, F, *Plates 22 to 24*, have been carried out by a forest guard who is so excellent that his name should be in print and I therefore give it—Laxuman Gopala. He has been from 20 to 30 years on the same beat and has got these plantations done without any cost to Government. I made him sit in each photo to give an idea of the size of the seedlings and poles.

In these six plantations the annual rainfall is about 24 inches, altitude above sea level about 1,700 feet, and soil the usual Deccani trap detritus with an admixture of black alluvial.

Photo.-Mechl. Dep., Thomason College, Roorkee. A.

B. Photos. by L. S. Osmaston.

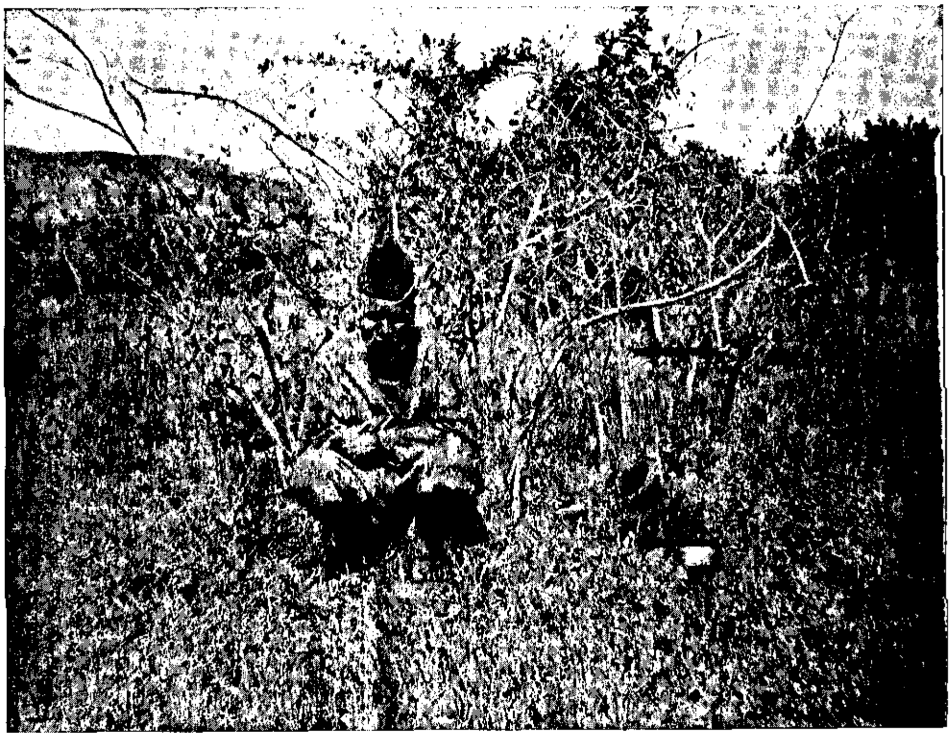
Some Plantations in the Satara District, Bombay.

Photo.-Mechl. Dep., Thomason College, Roorkee. C.

D.

Photos. by L. S. Osmaston.

Some Plantations in the Satara District, Bombay.



E.

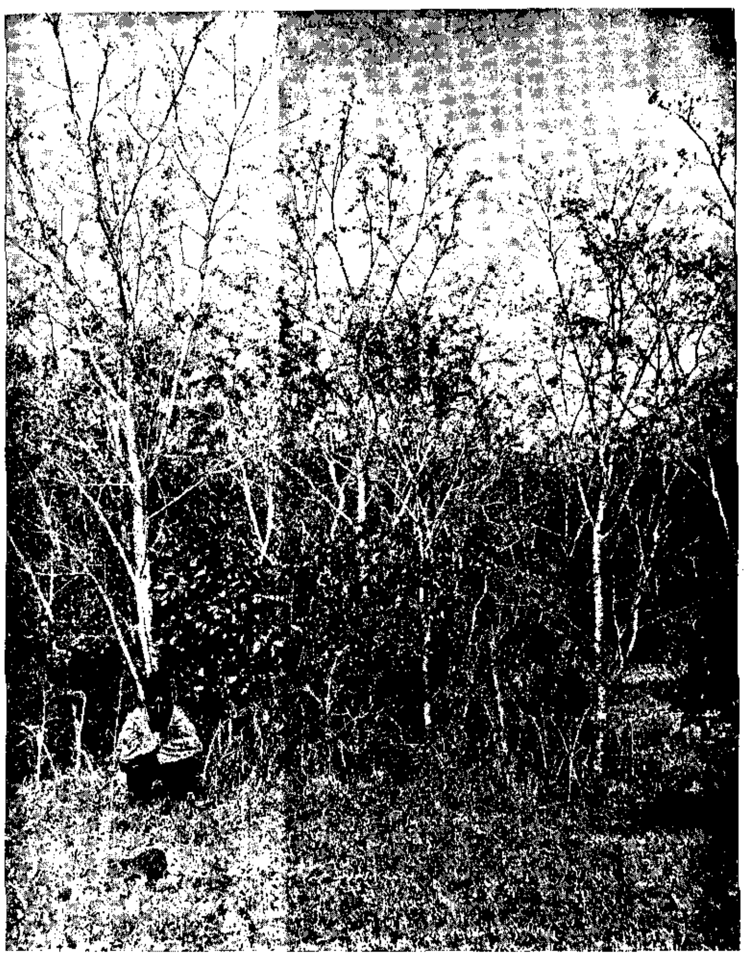


Photo-Mechl. Dep., Thomason College, Roorkee. F. Photos. by L. S. Osmaston.

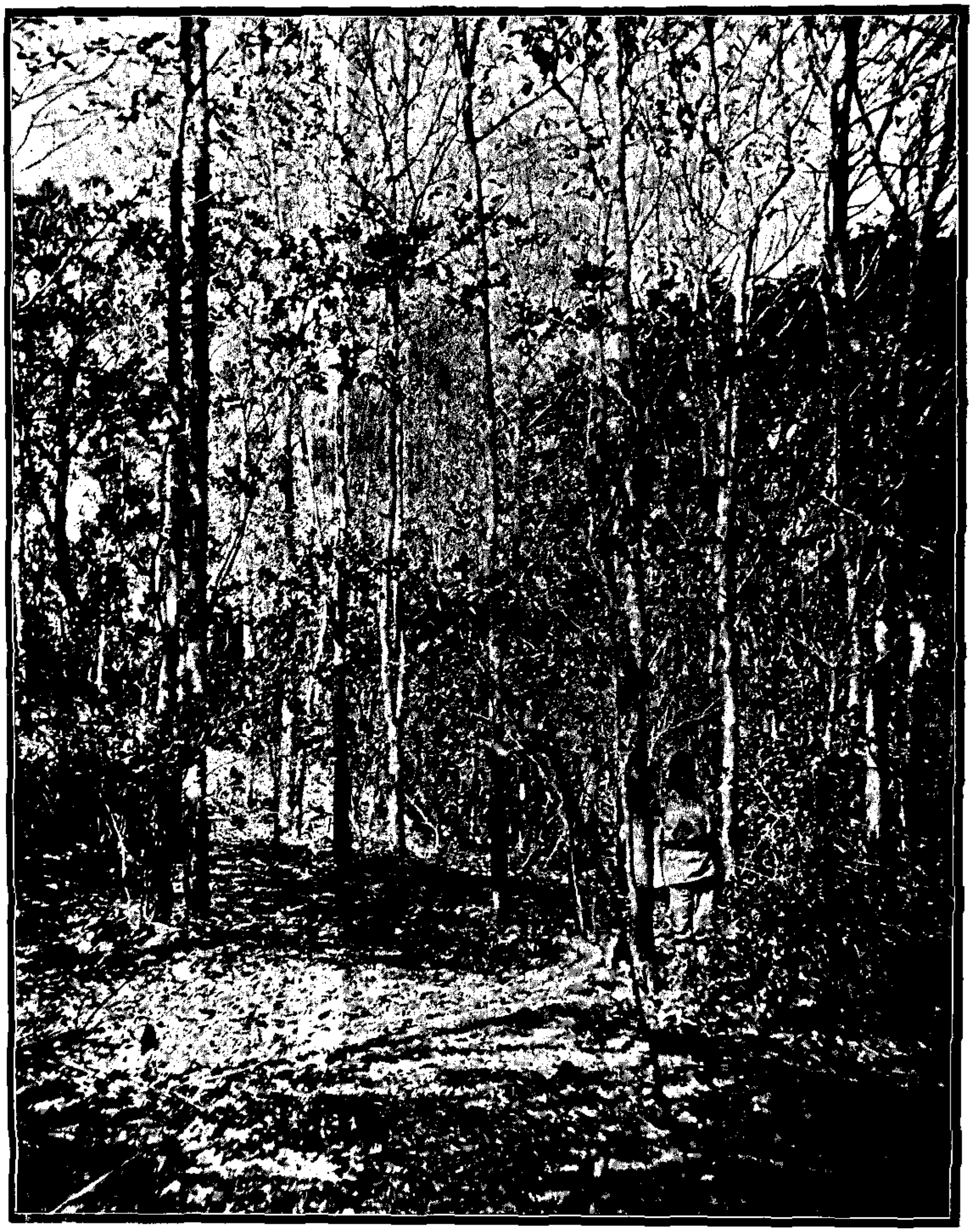


Photo-Mechl. Dep., Thomason College, Roorkee. G. Photo. by L. S. Osmaston.

Some Plantations in the Satara District, Bombay.

Teak here does not reach a height of over 35 feet or so, except in exceptionally favourable localities (as in photo G), Plate 25.

2. *Preparation of the teak seed.*—To make the teak seed germinate the same year it is produced, the following steps are taken with uniformly excellent results :—

In April a hole is dug in the ground anywhere out in the sun and large enough to hold all the seed: the hole may be as deep as you like to dig it : the seed is thrown into the hole and is then covered over with a layer of soil 1 inch deep. Every third day this "pocket" of seed is thoroughly drenched with water, so that the water rises to the top of the hole. This is done continuously for six weeks. The seed is then taken out of the hole and spread in the sun for three weeks. The rains are then about commencing and the seed should be sown as soon as the ground is prepared.

3. *Preparation of ground for plantation in case of plantations A, B, C.*—When the first monsoon rains (there is no S.-E. monsoon here but only the S.-W. monsoon) soften the soil, the land is double cross ploughed and then harrowed. The ground is now ready for sowing which should be undertaken at once. Sowing is done by hand and to cover up the seed an agricultural implement like a heavy blunt iron horizontal knife about 2 feet long is run over the soil. Weeding is done two or three times in the first rains and two or three times in the second rains and then the plantation is left to itself.

4. *Photo A*, Plate 22.—A pure teak plantation six years old. There is no grass on the ground because of a forest fire.

5. *Photo B*, Plate 22.—A 12 or 13-year-old plantation of teak, *Acacia Catechu*, *Terminalia tomentosa*, *Pongamia glabra* and *Melia Azadirachta ;* also a few mango which have done badly. Laxuman is sitting close to a teak and immediately behind him is an *Acacia Catechu* in flower, and in the middle of the picture at the same distance from the camera as the *khair* a *Pongamia glabra*. The teak and *Terminalia tomentosa* are in fruit which shows that these trees in this locality seed at the age of 12. The largest teak (not shown in the photo) in this plantation had a girth of 18 inches at breast height and was 22 feet in height.

6. *Photo C*, Plate 23.—A pure plantation of *Hardwickia binata* just coming into beautiful fresh pink leaf. The seed was, I believe, obtained from Nasik or Khandesh; age 11 or 12 years; no seeding yet. *Hardwickia binata* seedlings for some four years remain bushlike in form (not more than 1 feet high) and then put up a leader.

7. *Photo D*, Plate 23.—This is an example of plantation by seed patches. The soil in each patch is dug out to a depth of 6 inches and then it is *all* replaced after being broken up small. The tree seed is sown in or before the 1st monsoon rain. The patch is weeded once or twice a year for three years.

The patch in the photo is of pure teak 9 or 10 years old. These patches do not do so well as the ploughed and harrowed plantations of photos A, B, C, and I believe the reason is because of the effect of the grass which remains close round the patches and because only the soil in the patches themselves having been worked. A good many patches are blank and I have picked out a good one for the photo. Each patch is about 5 feet square.

8. *Photo E*, Plate 24.—A teak seedling 4 or 5 years old sprung from seed dibbled in on the north side of a thorn bush (*Gymnosporia montana.*) The object of this kind of plantation is to make use of the protection from sun and cattle afforded by bushes and to utilise the fact that in sparsely clad lands the soil in and round whatever growth there may be is more and better in quality than out in the open where it is not protected from erosion, nor added to by the annual fall of leaves from the bush or tree.

In this photo the teak is not easily distinguishable and two horizontal black lines have therefore been drawn to show the base and apex of the plant: it is small for its age and its poor development is probably due to no weeding: it should however soon be strong enough to put out a good leading shoot and go ahead.

9. *Photo F*, Plate 24.—The upper storey is of *Anogeissus latifolia* just coming into leaf, the lower storey of bushes of *Carissa Carandas* and *Ixora sp.*

This plantation was about 15 years ago a grass field: it was then taken into forest and *without any preparation of the soil*

Anogeissus latifolia seed was broadcasted over the area. This broadcasting was, I believe, the origin of the upper storey, for there are no trees of *Anogeissus* near, from which the seed could have fallen ; there is no doubt the broadcasting took place and the age of the upper storey falls in with the period of broadcasting.

The lower storey is of bushes which have edible seeds and I fancy birds have been the cause of the stocking by these two species which are plentiful in the vicinity.

10. *Photo. G*, Plate 25.—A 20-year-old plantation of teak which has just been thinned for the first time: the locality is especially favourable as it is a narrow strip along a river bank with good alluvial soil.

Unfortunately I have been unable to get any record of how the plantation was made, that is, whether teak seed was sown *in situ* or plants transplanted from a nursery: the cost is also unknown.

11. *General.*—The cost of plantations A, B, C would, I estimate, come to about Rs. 8 per acre in the Deccan. One man could make about a dozen plantation D patches in a day which at 4 annas daily wage would be 4 pies a patch and the weeding would add a pie or so more ; this at 500 patches per acre works out to Rs. 14 per acre.

The cost of plantations E and F would of course be very small indeed.

The photos were taken last month (in May) so the teak was not in leaf.

Patch plantations can be made on quite steep ground if care be taken to raise the lower end of the patch so as to make the surface of each patch as level as possible, thus preventing washing away of soil and seed.

L. S. OSMASTON, I.F.S.

June 1908.

REVIEWS AND TRANSLATIONS.

GLIMPSES INTO THE LIFE OF INDIAN PLANTS.*

This small book is an introduction to the study of Botany intended primarily for use in Indian schools. The book has no pretensions to being a text-book. Its great merit is the representation of many Indian plants and of many phenomena of plant life in such a way that the student is not only taught to observe and think, but, if his mind is open to the influences of Nature-study, is prompted to further study.

The first part is a description of a number of easily accessible plant types, arranged systematically, and also purports to be a description of the families to which these belong. Interesting points in the structure, œcology and uses of the selected plants are demonstrated. The descriptions of the families would, however, be inadequate in practice for classifying other plants of the groups dealt with, and are rather indications of the lines on which families may be discriminated.

The second part of the book contains a very brief introduction to anatomy, general morphology and physiology and an appendix gives a short note on scientific nomenclature.

The author endeavours throughout to explain the causes of or the reasons for, the structures which he describes. This attempt sometimes appears to be carried too far and causes are indicated, which, without further proof, cannot always be accepted as the correct or only ones. On p. 170 we read that " If we cut a young twig of a tree, we can see drops of its sap ooze out from the wound. If a branch or the stem of a tree is tightly tied round, we can often notice a swelling over the part which is tied. These two facts clearly prove that the sap not only ascends but also descends in the stem." Here the premises do not appear to warrant the

* Glimpses into the Life of Indian Plants. An elementary Indian Botany, by I. Pfleiderer, pp. vii + 206. Published by the Basel Mission Book and Tract Depository, Mangalore. Price Re. 1-8-0.

conclusion. The reason given for the cucumber having large leaves is that "they cover more ground than small ones, hence they prevent evaporation of water from the soil in a greater measure than could be done by smaller leaves." Two of the reasons adduced (p. 58) for *Vinca rosea* being so hardy are "that the roots are long and extend beyond its branches. This enables it to get water from a greater space than most plants of its size can. The numerous long branches, of which the tips only are erect, enables the plant to shade the ground well, and consequently the sun and wind cannot dry it up to the same extent as they would do, if the plant were erect." But if *Vinca rosea* is grown in a dry soil the leaves are small, and the plant gives practically no protection to the soil. In the grasses, we are told (p. 130) that "the ligule prevents the rain-water running down the leaves from entering under the sheath and thus rotting the tender parts of the culm." In the plantain, on the other hand, that "the midrib forms a canal on the upper surface which leads the rain water to the central part of the plant, which consequently need not have a very wide net-work of roots." All this may be perfectly true, but it is not made sufficiently clear to a child why, *e.g.*, in the mango (p. 22) it is said to be advantageous to the plant to throw the rain-water to the periphery of the crown; in *Vinca* the plant throws its roots beyond the crown, in the plantain the water is thrown to the base of the stem, while a similar disposition of the leaves in the grasses rots the stem. It is stated (p. 33) that sensitive leaves assume the vertical position of a night to prevent the deposit of dew interfering with the transpiration currents. I am not aware whether this theory has been substantiated, but the position of sleep may be observed on dry nights in months when no dew is deposited.

On p. 139 it is said that "the fronds of the ferns are not in a position to live during the dry season. As they are unprotected against dryness they have to wither and can continue their lives only through spores or through their root-stocks, which bring forth new fronds in the following rainy season." Here the fact that the fern fronds known to the author wither in the dry season is made the basis of a generalisation that they are insufficiently protected against

drought, and this in turn is given as the cause of their withering. But many fern fronds which die annually are more coriaceous than the leaves of some plants which successfully survive the dry season. It is, moreover, *not a fact* that all, or even nearly all, fern fronds die in the dry weather. *Stenoloma chinensis*, a fern of moist valleys, and *Gleichenia dichotoma*, a fern of sunny slopes, which are both in full leaf in the dry season with a shade temperature of over 100°, may be cited as examples to the contrary. Speaking of the plantain "*Musa paradisiaca*" the author states that "we see a great anomaly" in that "the numerous seeds are usually not developed. This is the result of man's interference with the natural growth of the plant, as can be observed in the wild species, *Musa superba*." Why *Musa superba?* The wild state of the author's *M. paradisaica, viz., M. sapientum, L.* also has numerous seeds.

The description of the perianth of Musa, as consisting of two dissimilar leaves, is very unsatisfactory, and quite ignores the significance of their arrangement and lobing. In fact, the author's morphology generally has rather a musty flavour, and is the weakest part of the book. In the description of the grasses, rice being taken as the type, it is stated of the glumes that "we can distinguish an outer pair representing the calyx, and an inner one, the corolla," apparently following Roxburgh or the Genera Plantarum of Linnaeus. In all cases he regards the so-called calyx-tube as *really* a part of the *calyx* instead of the *floral axis*, and it is rather jarring to hear that in the *Jamun* (*Eugenia jambolana*) the calyx "becomes fleshy and coloured, forming part of the fruit," while (p. 178 and corrigenda) "sometimes the ovary is inferior, that is, below the *lobes* of the calyx (sunflower, *Crinum*)." On p. 45 in describing the cucumber, it is said that "the calyx is completely united to the yellow corolla, only its 5 teeth being free."

There is an unfortunate tendency to vilify certain plants. Why, for instance, should Shelley's beloved Sensitive Plant be referred to as "the well-known but much-hated Sensitive Plant," the epithet should be qualified. On p. 56 again, *Ageratum conyzoides* is dubbed an "ill-weed." It is no doubt troublesome

to cultivators, but in Nature-study it is preferable to treat plants from a different standpoint.

In the matter of classification the author adopts the system of Bentham and Hooker, but for some reason substitutes the term Choripetalæ for Polypetalæ, and Sympetalæ for Gamopetalæ, as though he had at first intended to pursue one of the continental systems.

It might be well to draw the author's attention to the following apparent slips or errors. On p. 37 it is said that "the double rose (*Rosa centifolia*) does not grow wild. It is man's industry and skill which have produced this beautiful flower from the wild kind that grows in hedges (*Rosa canina*)." Apart from the facts that *R. centifolia* is a *wild* Caucasian and Assyrian species, and that *R. canina* does not grow wild in India, garden roses have a very multiple origin from several European and Asiatic species, besides those mentioned. It may be remarked, too, that it is only a matter of taste as to whether the double rose is more beautiful than the Dog rose, as is implied. Personally we prefer the single and less artificial flowers. On p. 14 it is stated that the part of the Tea plant from which the beverage *tea* is made are the *leaf buds*. The two or even three young leaves which are plucked together with the terminal bud can *not* be accurately included in the designation of *bud*. The Lentil is not the same plant as the Bengal Gram as would be gathered from p. 31. *Pinnate* (p. 32) does not mean "having the leaflets in opposite pairs."

On p. 40 it is said of the Myrtles that "their veins run parallel with, and just inside, the margin." The terms *Orders* and *Families* are treated as synonymous throughout the book. This is not in accordance with the latest international rules for nomenclature. On p. 45 the tendril is said to *shrivel up*, instead of to *coil up*.

On p. 56 *Chrysanthemum indicum* is included among plants with the florets all ligulate and similar. The example is unfortunate because only specially cultivated forms have lost their tubular florets. The statement (p. 57) that "the shrub *Nyctanthes arbor-tristis* is also a Jasmine" is very apt to puzzle a young student.

P. 61 *Calotropis* "yields a fibre in its seed pods." The fibre referred to is evidently the silk floss or coma of the *seeds*. In describing the flowers of *Convolvulaceæ* (p. 64) a forked *pistil* is referred to, where a forked *style* or 2-fid stigma is meant. On p. 68 the fruit of *Capsicum* is classified as a capsule, whereas it is a berry. On p. 74 the Labiate family is said in the diagnosis to have 4 stamens, but one of the types dealt with is *Salvia* which has only two stamens and this should therefore be mentioned. The distinction between *Acanthaceæ*, *Verbenaceæ* and *Labiatæ* (p. 78) is not well brought out, and the statement that the seeds of *Acanthaceæ* are "attached by hooks" is liable to conjure up a wrong mental picture of the real state. On p. 79 lime is said to be *Calcium phosphate*. On page 83 the Nettle Family is said to have "minute flowers often crowded on a fleshy body, called *involucre*." One could scarcely call the fleshy receptacle of a Jack fruit an involucre. There are some other evident slips or misprints which should have found a place in the corrigenda at the end of the book.

An essential feature of the book are the illustrations, most of which are excellent. Most appear original, others seem familiar, but as their source is not quoted this may not be so. Exception may be taken to the Banyan leaf in Fig. 124 which scarcely represents an *ovate* leaf, and figure 127 is not an *oblong* leaf. The second position of the stamens in *Clerodendron infortunatum* shown on p. 179 is interesting, and shows the two pairs of filaments much less divergent than I have usually noticed them in Upper India. The book has great educational value and should be a useful addition to Indian school books as well as a most valuable help to amateur beginners in botany. It requires, however, a careful re-editing.

H. H. HAINES.

CURRENT LITERATURE.

NOTE ON THE UTILISATION OF KHAIR FORESTS IN EASTERN BENGAL AND ASSAM.—By Mr. Puran Singh, F.C.S., who is acting as Imperial Forest Chemist. This note forms No. I of the new Forest Pamphlet Series as instituted by the Inspector-General of Forests' circular printed on page 372 of the *Indian Forester* for June 1908. This pamphlet forms also No. I of the Chemistry series. Mr. Puran Singh refutes the opinion generally held that *Acacia Catechu* growing in moist climates or on river banks contains no catechu and consequently yields no *katha* and that it is unfit for the manufacture of cutch. The proportion of catechin, in the samples of such wood from Goalpara was found to be much less than in wood grown in a dry locality in the Siwalik Division, U. P., but at the same time a considerable amount of catechin was found to exist and in one sample the proportion was found to be as much as one half of that found in the wood from the dry locality. Mr. Puran Singh succeeded in making cutch from the sample woods from Goalpara and found that although the proportion of catechin in the wood as already stated was less than in the case of wood from dry localities, the proportion of catechin in the cutch made from the wood was higher in the former case than in the latter. Two plates accompany this pamphlet illustrating the colours obtained by dyeing linen with Assam cutch. The author concludes that the Assam wood is suitable for the manufacture both of *katha* and cutch. There is, he says, no doubt that wood of *Acacia Catechu*

with white spots yields more extract and a greater amount of catechin than that without spots, but that is no reason why wood without spots should be declared wholly unfit for *katha* making. In the light of the fact that the Goalpara wood, which is without spots, yields a cutch with a fairly high percentage of catechin, the practice of declaring all woods without white spots unsuitable for *katha* manufacture appears to be rather absurd. The author believes therefore that the presence or absence of white spots in the wood cannot be relied on as a test whether it is fit for *katha* making or not, and he recommends that a preliminary assay as described in the concluding paragraphs should be made of each tree to be felled. We congratulate Mr. Puran Singh on this pamphlet which contains an amount of very useful information on the subject.

REMARKS ON INDIAN SCALE INSECTS (COCCIDÆ).—*Memoirs of the Department of Agriculture in India, Entomological Series, Vol. II, No. 2.*—This brochure is by E. E. Green, Government Entomologist, Ceylon, with original illustrations by the author. It forms Part III of the series on this subject but the first two parts appeared in the now defunct "Indian Museum Notes." The present paper besides recording several species hitherto known only from other countries, describes eighteen species new to science and two new varieties. The author concludes with a catalogue of all species hitherto recorded from the Indian Empire.

THE CANADIAN FORESTRY JOURNAL FOR MARCH 1908.—This number opens with an account of the ninth annual meeting of the Canadian Forestry Association which was held at Montreal on the 12th and 13th of March 1908. The twenty-two pages occupied by this subject afford a great deal of interesting reading, but for details we must refer our readers to the Journal itself. The greater part of the remaining pages is occupied by papers which were read at the above meeting, *viz.*:—

"The President's Address," (Mr. H. M. Price); "La Manière dont quelques Cultivateurs usent du Bois et de leurs Terres" by Mgr. J. C. K. Laflamme; "Forest Survey Methods" by A. H. D. Ross.

We learn that a new society called "The Canadian Society of Forest Engineers" was organised on the 13th March 1908. The object of the Society in the words of its constitution is "the advancement of its members in the theory and practice of forestry by the discussion of technical and professional topics, the promotion of a better mutual acquaintance among Canadian foresters and the cultivation of an *esprit de corps* among the members of the profession."

FORESTRY AND IRRIGATION FOR JUNE 1908.—*Practically the* whole number is devoted to an account by F. G. Heaton, the Editor, of the "The Governor's Conference," the historic gathering held at the White House on 13th to 15th May 1908. It is evident from the addresses delivered that the conservation of the natural resources is now becoming generally recognised in America as the most important problem of to-day. The cause of forestry will without doubt be greatly helped on by this noteworthy conference, and we trust that the lessons to be derived therefrom will not be lost on other countries, in which the urgent need of protection and extension of forests is not yet recognised.

We quote the following extract from the address of the Hon. W. J. Bryan at the close of the proceedings :—

"No subject has been brought out more prominently at this conference than the subject of forestry, and it justifies the time devoted to it, for our timber lands touch our national interests at several points. Our use of timber is enormous, but immense as would be the inconvenience and loss caused by the absence of timber, the consequence of the destruction of our forest would be still more disastrous to the Nation. As has been shown, the timber on our mountain ranges protects our water supply. Not to speak of changes in climate which might follow the denuding of our mountains, the loss to the irrigated country could not be remedied and the damage to the streams could not be calculated. And if this is not enough to arouse the interest of all, I may add that the destruction of the forests on the mountain ranges would in time impair the under-flow upon which we rely for our well water."

FORESTRY QUARTERLY FOR JUNE 1908.—Mr. H. S. Graves contributes a very interesting article on the "Natural Reproduction of Forests" which, as the author states, at present constitutes one of the most important lines of research of the American forester. Other papers are :—"The Forest Problem in a Rich Agricultural Country of Ohio" by O. E. Baker; "Conversion of Coppice under Standards to High Forest in Eastern France" by A. F. Hawes. The number contains as usual a great many pages devoted to valuable notes on current and periodical literature.

THE BOTANICAL GAZETTE.—*In the issue for May 1908*, Mr. W. S. Copper contributes a valuable paper on the "Alpine Vegetation in the Vicinity of Long's Peak, Colorado". In this he traces the successive stages of vegetation from the smallest beginnings up to tree forest. A series of unique photographs accompanies the article.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

ALLEGED CASES OF NEST-BUILDING BY PARASITIC CUCKOOS.

The path of the zoologist is beset with pitfalls. There exist, I am informed, certain mischievous persons who deliberately lay themselves out to, what is, in the slang of the day, called "pull the leg" of the respectable man of science by furnishing him with detailed accounts of events that have not taken place. Against these inventions the naturalist has constantly to be on his guard. There is another class of purveyors of lies, still more difficult to guard against, because the inaccurate information served up by worthies of this class is *boná fide* and usually lacks the element of humour which should suffice to betray the concoctions of the wag.

Cuckoos, owing to their strange habits, have long attracted the attention of the multitude; it is, therefore, not surprising that

these birds are the heroes of many fictitious episodes in natural history.

Numbers of persons have imagined that they have come across a respectable cuckoo of the species *Cuculus canorus* that has turned away from the sins of its kind and built its own nest. At one time the statements of these observers were readily accepted by ornithological authorities, but of late years the ways of the European cuckoo have been observed by a multitude of competent persons, and as no one of these has ever observed any attempt at nest-construction, on the part of the bird, the statement by an amateur that he had observed it would not now be believed.

It may not be devoid of interest to consider some of these old cuckoo stories.

Upon one occasion "the Rev. Mr. Stafford" when walking in Glossop Dale saw a cuckoo rise from her nest. The nest was on the stump of a tree which had been some time felled, among some chips that were in part turned grey so as to resemble the colour of the bird. In this nest were two young cuckoos ; tying a string about one of them he pegged the other end of it to the ground, and very frequently for many days beheld the old cuckoo feed her young as he stood behind them.

Another well-known case was also observed by a clergyman—a Mr. Wilmot. One of the men working on his farm informed him that there was a bird "exactly like a cuckoo" sitting on a nest on a coal-slack hill. Going to the spot Mr. Wilmot was "perfectly satisfied" that the bird was a cuckoo. The nest, which was merely a hole in the manner of a plover's nest, contained three eggs. He informed Mr. Holyoak of the occurrence and that gentleman visited the spot and was also perfectly satisfied that the bird was a cuckoo, and thought her more attentive than any other bird he had observed, having always found her brooding her young ones.

These instances were recorded before the days of Jenner. We now know that two young cuckoos cannot live in the same nest because the stronger invariably ejects the weaker. The fact, then, that there were in each nest more than one young cuckoo renders it clear that the birds were not cuckoos. There can be but little

doubt that in each case the bird seen was a goat-sucker, which is sufficiently similar in appearance to the cuckoo to deceive the uninitiated.

Similar instances are on record of one of our Indian hawk-cuckoos—*Hierococcyx sparverioides*,—building its own nest. This bird is a near relative of the famous brain-fever bird and has the same crescendo shriek that renders the latter such a source of irritation.

The hawk-cuckoos are all parasitic and victimise the various species of "seven sisters." The instances of *H. sparverioides* constructing a nest have all been in the Nilgiris. Many years ago a Mr. R. H. Morgan of the Indian Forest Service informed Mr. Davidson that he saw that species build a nest and lay in it four pure white eggs, which he appropriated.

The other instances are recorded in detail by Miss Cockburn as follows :—" On Saturday, April 11th, 1874, I sent two servants (good nest-finders) to a small swamp at an elevation of about 4,000 feet, where there were a few pairs of white-breasted water hens, to seek for their eggs. Not finding any their attention was drawn to a clump of trees at the edge of the swamp, from one of which a hawk-cuckoo flew out. On watching it they saw it return to the same spot, and on looking up into the tree there was a large nest, of mere sticks, resembling a common crow's nest, but with the cuckoo sitting in it. One of the men immediately climbed up, and found three eggs in the nest. He descended again, and the other servant, who had a gun fired at the bird and missed. The cuckoo flew away, but returned after some time to be fired at again. This shot being a long one was again missed, and as it was then very late, one egg from the nest was brought away. Next day being Sunday nothing could be done. On Monday 13th they started very early, and reached the place about half past eight o'clock. The cuckoo was still there and was shot. Though the people were there for about three hours on Saturday, and an hour or two on Monday, they saw only this one bird. Is the work of nidification, which may be called 'a labour of love' left to the female entirely by this species ?

"The nest was placed between three upright branches, at the measured height of 27 feet from the ground; it was tied together and brought to me. Its dimensions are 20 inches in length, 15 in breadth, 6½ in depth. The hollow in the centre for the eggs is oval, 5 inches long, 3 broad, 1½ deep. The nest is almost entirely built of the same kind of twigs: two or three of them are thick and have a little lichen sticking to them. Nothing like lining is added. The eggs were three in number, perfectly white, with a few touches of light brown on two of them; they were much incubated. The inner skin of these eggs has a greenish blue colour.

"On May 21st, 1874, I went to see another nest of the large hawk-cuckoo, which had been discovered a few days previously. It was placed along several branches (which grew horizontally) of a very large tree, on the side of a steep hill, the ground stony and ploughed, and at about 4,500 feet of elevation. The nest was more to one side of the tree than the other, situated among thick foliage. A ladder had to be ascended to reach the nest; it contained no eggs or young, but a quantity of droppings of the birds. It appeared to be a nest that had been used for several seasons, as there was a large accumulation of thin sticks, giving the idea of a few fresh ones having been added when the abode was required at the return of each breeding season. I saw the birds near the tree, but they did not approach the nest while I was there. However, my servant said that he saw one of them sitting on the nest a few days before. I have no doubt as to the identity of this nest, as it was exactly like the one found a short time ago containing three eggs."

Such is the evidence in favour of nest-building propensities of *Hierococcyx sparverioides*. Hume quotes it in full in his "Nests and Eggs of Indian Birds," but forbears to comment upon it. Blanford in the "Fauna of British India" writes, "but the bird is believed by both Miss Cockburn and Mr. R. H. Morgan to build its own nest." He makes no further comment. Thus the attitude of Hume and Blanford towards the alleged occurrence was that which politicians call "sitting on the hedge." Neither of these

gentlemen seem to wish to commit himself. But the fact that they mention Miss Cockburn's belief has resulted in this cuckoo being cited in some popular books as an example of a cuckoo which builds its own nest.

In a case such as this the proper course obviously is to apply judicial test to the evidence before us. This is a precaution which scientific men frequently neglect to take.

Mr. Morgan's evidence is very meagre, he averred to Mr. Davidson, who told Mr. Hume that Mr. Morgan had watched a hawk-cuckoo build a nest. This evidence is therefore hearsay and would not be admitted by any Court of Law. Of Miss Cockburn's statement that relating to the first nest is all hearsay; she merely repeats what her native servants told her. She certainly saw the second nest with her own eyes, but she did not see a cuckoo in it. Thus the evidence brought forward by her resolves itself into unconfirmed statements made by native servants, who are most untrustworthy witnesses.

Some months ago my climber came to me saying that he had just seen a hen koel enter a crow's nest, lay an egg in it, and then fly away with a crow's egg that was already in the nest. Going to the place I found a koel's egg in the crow's nest. As the nest was at some distance from my bungalow I removed the egg to a more convenient crow's nest. This egg hatched out within forty-eight hours of the removal and thereby proved that my climber's story was a fabrication.

A native servant usually tells his master not what he has seen but what he imagines will please his master.

I am convinced that the story by which Miss Cockburn's servants delighted their mistress was either a deliberate fabrication, or *bonâ fide*, the servants mistaking on the first occasion a hawk for a cuckoo.

I am glad to observe that Mr. E. C. Stuart Baker disbelieves the story.

Hodgson and Rattray assert that according to their experience in the Himalayas the large hawk-cuckoo is always parasitic. Moreover during the thirty-four years that have elapsed since the

finding of Miss Cockburn's nests no one else has seen a hawk-cuckoo constructing a nursery.

Mr. Stuart Baker points out several other reasons which seem to show that Miss Cockburn's nests were those of a hawk's. The colour of the egg-lining points to its being that of some falcon. Moreover, Miss Cockburn states that the second nest appeared to have been used several times, and it contained a number of droppings. These two facts point to a hawk. Finally the statement of the servants that they had seen the cuckoo sitting in the second nest is improbable. The bird would only sit in the nest if there were either eggs or young birds in it. In that case it is almost certain that Miss Cockburn would have seen the young birds with the parents, but she saw only the parent birds.

I may here add that the story told by her servants is not intrinsically impossible, for some cuckoos are not parasitic. Nevertheless the story is most improbable. Those who live in the Nilgiris would be rendering a service to ornithology if they would in future make a point of observing carefully the ways of *Hierococcyx sparverioides*.

D. D.

THE PERIOD OF GESTATION OF MAMMALS.

In consequence of the imperfect knowledge existing as to the period of gestation of many mammals, Dr. O. Heinroth, of the Berlin Zoological Gardens, has been carefully studying the subject, and he has just published the result of his observations in the *Zoologischer.* It appears that the hoofed mammals go the longest term of gestation in the whole class. In the Indian elephant the period ranges from 20 months 21 days to 22 months, the giraffe 14 months, the American tapir 13 or 13½, the Indian tapir 13, the Somali wild ass and its domesticated relative, the mountain zebra, and the Asiatic wild ass about 12 months, Burchell's zebra 11¼ to 13, and the horse 11 months. Camels and llamas also occupy a high place. The term is 13 months in the case of the two species of camel, from 11⅓ to 13 in the llama, 11¼ in the guanaco, and 11 in the alpaca. In the Bovidæ the longest periods occur in the anoa of

Celebes (9½ to 10 months), and the beisa oryx (8½ to 10 months). The roedeer goes from 9 to 9½ months, Pere David's deer 9⅓, the cow, zebu, gayal, bison, yak, and sambur 9, eland and gnu from 8½ to 9, wapiti 8½, hippopotamus, nilgai, elk, hartebeest, sable antelope, and waterbuck 8, bushbuck, blesbok, and four-horned antelope 7½, blackbuck and chamois 6, springbuck 5⅔, chevrotain 5½, Nubian ibex, goats and sheep 5, and swine from 4 to 4¼. As to the primates, the anubis baboon is reported to go 7 months. In two species of lemur the period is stated as 3¾ months. In the carnivora the gestation is short, being about 3½ months in the lion and tiger, 3⅓ in the jaguar, 3 in the puma, leopard, and striped hyæna, 56 days in the cat, and 9 weeks in the wolf, jackal, and dog. On the other hand, the brown bear goes about 7 months, and the polar bear, it is said, approximately 8 months with young, while in the common seal and the Californian sea-lion the period is believed to be 11 and 11¼ months respectively. The rat and the house-mouse are thought to have the shortest time with 21 days each, while the hamster comes next with 22 days, followed by the domesticated rabbit with from 28 to 30 days. The great ant-eater goes 6 months, and the hairy armadillo 2 months, while the only record among marsupials is that of the great grey kangaroo with about 35 days.—(*Indian Field.*)

THE PRESERVATION OF RIPE FRUIT FROM DECAY.

The following information has been supplied by Mr. A. Howard, Imperial Economic Botanist, Agricultural Research Institute, Pusa :—

"Experiments on the best method of preserving ripe fruit from decay were conducted at the Jodrell Laboratory, Kew, in 1905 and 1906 (*vide* Journal Board of Agriculture, England, XII, p. 305 and XIII, p. 562), and among the various substances experimented with commercial formaline, 3 per cent solution in cold water proved most suitable. A dozen apples, showing the first

stage of apple-rot, were immersed for a quarter of an hour in a solution of the strength mentioned, and then dried. This was done in August, and in the end of November, the apples were found still in good condition. A dozen apples not so treated were completely rotten by the end of September."

The following was the method adopted :—

" Put 10 gallons of water (preferably rain) into a cask or zinc bath ; add 3 pints of formaline ; mix thoroughly ; then immerse as many apples, contained in a net or loosely woven sack, as the water will cover. The fruit after remaining in the solution for 10 minutes, the sack being partly lifted up two or three times to ensure every part of the contents coming in contact with the liquid, should be removed from the sack and placed on a layer of straw, hay, or some suitable substance to drain and dry. It is not necessary to immerse in water, after their removal from the formaline mixture, apples that are intended for storing"—(*cf.* Journal Board of Agriculture, l.c.). The formaline method was also found efficacious in the case of plums, bananas, currants, cherries, gooseberries, grapes, pears, and strawberries, and it is stated that this method might be advantageously employed in the case of tropical fruits intended for exportation.

TIMBER IN SOUTHERN NIGERIA.

In the report on the forest administration of Southern Nigeria for 1906 the following observations are made :—As regards the prospects of profitably exporting timber other than mahoganies and cedars to Europe, it may be mentioned that under the existing conditions of freight and labour it does not pay to export woods that realise less than 3*d.* per superficial foot. A large number of different kinds of West African timbers can easily command from 2*d.* to 2½*d.* a superficial foot in the Liverpool market if presented in the form of sound, carefully prepared, and seasoned logs, but unfortunately the expense of hauling the timber by human labour is too great to admit of any profits being made from such prices. The timber industry of Southern Nigeria can never be developed

to its full extent unless human labour is replaced by mechanical appliances or by the employment of draught animals. Supervision by European contractors skilled in the use of such appliances would also be necessary.—(*Indian Engineering.*)

SYNTHETIC RUBBER.

The London Synthetic Rubber Co. claim to have made decided progress in the way of turning out the material indicated by their title. I have not seen any of the product personally, but a friend of mine, who, by the way, knows nothing about rubber, tells me that he has seen a sample, and that it was strong and elastic. It appears that the price of production has so far been too high for business purposes, and that it is recognised that production at a shilling per pound will be necessary for its successful exploitation. A considerable reduction, I am assured, has been effected already, though they are still some way off the shilling cost desired. Meanwhile it is stated that the £100 shares, with £10 paid up, are quoted at £400 each. From another source I gather that Peru is going to knock all other rubbers, natural or synthetic, out of the market when the arrangements now in hand in the upper Amazon Valley for the facilitation of freight and the augmentation of labour come to maturity. No date, however, appears to have been fixed for this development. Clearly, if one believes everything he hears, the rubber plantation people may not have everything their own way, after all.—(*India Rubber World.*)

CREOSOTE AS A WOOD PRESERVATIVE.

Creosote is of course a valuable agent to preserve wood against decay. The Forest Service of the United States is publishing information about it. A recent pamphlet is "The Analysis and Grading of Creosotes," by Arthur L. Dean and Ernest Bateman. The following is an extract from this publication: "A pure coal-tar creosote will protect properly treated

timber for a great many years. What protection will be afforded by the distillates from other kinds of tar is as yet an open question, but the increased production of these tars and the growing practice of distilling them make it imperative that definite information regarding their preservative value should be acquired. At present, despite the apparent approximation to the composition of coal-tar creosotes by the creosotes from oil or water-gas tars, the known preservative value of the pure coal-tar creosotes makes them of greater market value. We must, therefore, regard the creosotes obtained by the distillation of properly made coal-tars as the highest grades for preservation."—(*Indian Engineering.*)

VOLUME XXXIV NUMBER 10

INDIAN FORESTER

OCTOBER, 1908.

THE EFFECT OF FORESTS ON RAINFALL.

We have often alluded to this important subject in the pages of the *Indian Forester*, but we venture to think that it may not be unprofitable for us to discuss this matter further, from a somewhat different point of view. There are many people still who do not believe in the beneficial effects that forests exert on rainfall, although in most countries it is now recognised as a fact. In the February issue we drew attention to M. Henry's proofs that extensive tracts of forest exert an influence on the air, both as regards temperature and degree of moisture, to a considerable height (4,000 to 5,000 ft.) thereby rendering the conditions for the precipitation of rain more favourable.

The point of view that we now wish to discuss is the effect of forests on the total supply of moisture in the atmosphere of the world. Our attention has been directed to this point of view by an article entitled "La Marche Retrograde de la Végétation,"* by M. Ducamp in the *Revue des Eaux et Forêts* for 15th May 1908.

* We publish in this issue on page 600 a translated abstract of the article in question.

As far as we know, practically the whole supply of moisture in the atmosphere of the world is derived from evaporation, and thus the rainfall is directly dependent upon evaporation. Now M. Ducamp states that it is a proved fact that under similar conditions the amount of water evaporated from a given area of leaf-surface is sixty times the quantity which would be evaporated from a free surface of water. He calculates that in an average forest the area of the leaves is at least ten times the area of the ground which supports the forest. If these hypotheses are true it follows that the amount of moisture evaporated under similar conditions from an acre of forest is six hundred times the amount evaporated from a free surface of water of the same area. Taking the proportion of land to water on the surface of the world as 1 to 3, and supposing that one-quarter of the land area is under forest, it follows that the amount of evaporation from forests, although the latter occupies only one-sixteenth of the surface of the globe, is fifty times the quantity of water evaporated from the water surface of the world. It therefore appears that the supply of moisture in the atmosphere is practically dependent on vegetation and that the quantity derived from direct evaporation from free surfaces of water is in comparison an almost negligable quantity. It follows that the rainfall of the world is chiefly dependent on the existence of forests, and *that in proportion as forests are destroyed, the* general rainfall must become less and less, and conversely all afforestation will tend to increase it. Thus the rainfall of the world is not only increased by the existence of forests but it is chiefly dependent on them. We have no doubt that if all the *forests of the world were to be destroyed, the rainfall of the world* would practically cease --and the land would become an almost waterless wilderness, as is now the case in the Planet Mars.

In the above we have only compared the evaporation from the forest area which we have supposed occupies one-quarter of *the land surface, with the evaporation from the water surface which* we have supposed occupies three-quarters of the entire surface of the world, or twelve times the area under forests. The evaporation from the remaining land area has not been taken into account,

for, in comparison with that from the forest area, it is very small. For the most part the area is under cultivation or is occupied by waste and desert. The cultivated area only supports crops for a small part of the year and the roots of the crops only obtain their water from close to the surface. The leaf surface of such crops on a given area is very small compared with the leaf surface of a forest crop on a like area. Hence the evaporation from the cultivated land is no doubt a great deal less in proportion than from forest areas. The evaporation from the waste or desert land is extremely small, for it is chiefly on account of the lack of moisture that such lands are uncultivated. It is not likely that the cultivated area will decrease, rather it is likely to increase, probably chiefly at the expense of the present forest area. It follows that if we wish to maintain the present rainfall of the world, we must necessarily maintain the present area of forests in the world, or, if we desire to increase the rainfall, we must increase the forest area by afforestation of waste lands.

Once this most important fact is universally recognized a minimum area of forest will probably be maintained in every country by international agreement, for the effects of forests on the supply of moisture to the atmosphere by evaporation are distinctly international, whereas their effects in precipitating moisture from the atmosphere are generally more or less local.

BRITISH FORESTRY.

IV.

In a previous paper was discussed the conversion of coppice or coppice with standards, constituting for the greater part of English woodlands, into high forest. There remains to be considered existing high woods, which, having been ruined as forest by drastic over-thinning, it is desired to bring into a productive state. One is very familiar with the aspect of woods planted 100 to 150 years ago. They often contain fine oaks, beech and elm, the spruce and

larch which were planted originally as nurses having been felled by degrees for use on the estate. At wide intervals occur silver firs, loftiest of European trees, which would have furnished splendid planking if they had been grown in a close mass by themselves; but being shade-bearers, carry rough side branches all along their boles, rendering the timber unworkable by reason of the knots. This has saved many noble specimens from the axe, but very commonly their heads, towering over the neighbouring trees, get sadly knocked about by gales. It comes as a revelation to a British forester, accustomed to regard the silver fir as hopelessly coarse for the saw-mill, to visit such forests as those in the Vosges and other Continental districts where the great grey trunks soar up smooth and straight as the piers of a cathedral, without a branch for 50 ft. or 60 ft.

The broad-leaved timber in the woods we are discussing has suffered by the almost universal application of the standing British rule that no tree shall be nearer its neighbour than one-third of its own height, whereby they have been encouraged to form wide-branching heads, as if the purpose were to grow an orchard instead of a forest. Upon trees thus top-heavy, any storm of unusual violence must tell with tremendous effect, rending great gaps in the canopy and often levelling everything over a considerable area. Such blanks, where the soil and climate are moist, either become a tangle of briar and fern, or throw up a growth of seedling birch, ash, or sycamore, the only trees which can establish themselves self-sown where the ground herbage is rank. In the eastern counties of England and Scotland, with drier soil and climate, the ground is much more favourable for natural regeneration, and oak, beech, and pine readily reassert themselves, provided that ground game are fenced off.

The mere mention of ground game tempts one to diverge into an essay upon rabbits as constituting the chief hindrance to profitable forestry in the United Kingdom. If any landowner would be at the pains to work out an estimate of what his rabbits cost him annually, he would not be content till there was not a single pair of these pests left on the ground outside his warren. His own and

his neighbours' rabbits, for without co-operation between neighbours there is no getting rid of these insatiable rodents, which travel great distances in search of "fresh woods and pastures new," and, so soon as they find them, set about establishing a record in fecundity. No planting can be attempted, even where rabbits exist only in moderate numbers, without the protection of wire netting, which entails a serious addition to the initial outlay. Suppose, for instance, that a square block of 64 acres is to be planted; it will require 2,240 yards of 1 ¼ in. mesh netting, 42 in. wide, erected on larch posts, with 6 in. of netting turned under the sod. Labour and material will cost certainly not less than *6d.* a running yard, or £56 for the entire length. But our woodlands seldom lie in squares; belts and irregular masses are much more frequent, often with sinuous outlines such as "Capability" Brown and his school prescribed as essential to fair landscape, the length of fencing required for such figures being indefinitely increased beyond that required for a simple square.

In preparing to deal with old and over-thinned woods, the proprietor is sure to be met with objections—very likely he will feel strong reluctance himself—against interfering with what is a delightful feature in any landscape; but the whole purpose of these papers is to show that the time has arrived when very few landowners can afford to maintain unproductive woodland, and that if woods are to be preserved, they must be managed on an economic basis. We hope to convince readers that this can be done without sacrifice of sylvan beauty—that the best æsthetic results, indeed, can only be attained as the outcome of sound forest treatment. The most delectable and special characteristics of English scenery consists in richly-timbered parks, the finest of which owe their origin to ancient forest. Take, as an example in the south, Lord Brownlow's park at Ashridge. Nowhere else shall you see such stature of beeches in dense masses, in detached groups and standing singly—the very perfection of tree growth. But do not imagine that such a result can be attained by dotting beeches about upon open ground. The Queen beech at Ashridge had never attained her height of 135 ft. with 90 ft. of clean bole, unless she had shared with ten

thousand sisters the discipline of high forest. Planted apart, her vigour would have expended itself in breadth of branches instead of soaring stem. Take another example from the opposite end of the realm. In the latter half of the eighteenth century, when Scottish lairds began to lay out park scenery in emulation of their fellow-subjects in the south, the fourth Duke of Gordon expanded the time-worn keep of Bog-o'-Gight into the vast dimensions of Gordon Castle, and laid out the park which now lies round it, planting therein many trees in the approved style. Yet it is not on that park that the visitor's eye rests and his memory dwells with most pleasure, for it is but a spacious mimicry of better things in the south ; it is that majestic company of Scots pines far up the Wishart Burn that stirs within him such feelings of admiring awe as only an ancient forest can kindle. These trees were planted nigh 200 years ago, with no decorative intent, but destined for the same utilitarian fate to which their owner turned the great forest of Glenmore, which was sold in 1783, took two-and-twenty years in the felling, and was floated down the Spey to the shipbuilders' yards at Speymouth.

Having submitted these examples in evidence that British sylvan scenery is in no danger of being marred by forestry reformers, whose purpose is to grow perfect trees instead of inferior ones, we may resume consideration of how to restore an ill-grown woodland. Generally one of two alternative courses must be taken ; either the standing wood must be felled outright and the ground replanted, or the old trees may be underplanted with shade-bearing species, which in time will take the place of the others when they are felled or succumb to old age. The first of these methods is usually the most prudent and least costly. The market for home timber must be many times worse even than it is at present if the old wood cannot be sold standing at a price which will more than meet the cost of replanting. Suppose, for instance, that a wood 100 years old has been so sorely over-thinned as to contain only 35 trees per acre, each containing 60 cubic feet of timber saleable at 9*d.* a foot, that is, 2,100 cubic feet per acre ; the yield per acre, £78 15*s.*, would cover the cost of replanting 10 or 12 acres. In

dealing with a considerable area of woodland in this way it will be expedient to treat it by what Dr. Schlich terms the shelter-compartment system, whereby a screen of the old wood is left standing until the new plantation has established a firm footing ; or else by the shelter-group system, whereby open spaces are cut out of the mass and planted up in successive years until the whole area has been replanted.

Objection may be reasonably made against dealing with certain woods in this manner on the score of landscape effect, in which case the alternative process of underplanting must be resorted to. For this purpose very few species of trees are available. Among hardwoods, beech is the only one that can be recommended, for, although hornbeam is its equal as a shade-bearer, it is far inferior to it in the other qualities of a forest tree. Moreover, beech has no rival in its virtue as a fertilizer, enriching the soil annually by its abundant leaf-fall, and creating humus more rapidly than any other tree. German foresters call it the Doctor of the Forest, for, in addition to its merit as a fertiliser, it is a beneficial neighbour to other trees in checking by its shade rapid evaporation and keeping down competing ground herbage. Of conifers, the best shade-bearer is undoubtedly the European silver fir, although its use has had to be discontinued in some eastern and northern parts of the kingdom owing to destructive attacks of aphis. Probably its failure in these districts is owing to lowered vitality caused by unsuitable climate, for the silver fir thrives most vigorously in the more equable temperature of the south and west of our islands. Some writers on forestry recommend the Norway spruce for underplanting high wood, but although it certainly endures considerable shade, and although the writer has seen very numerous instances of its use as undergrowth, he cannot call to mind a single instance in British woods where there was any prospect of its forming a successful crop. In no case must the error be committed of underplanting larch with spruce, for although these two species may be found growing together in natural forest, they have one very undesirable affinity. The plant louse of the spruce (*Chermes abietis*) in its winged form lays its eggs on the spruce needles,

and these eggs produce a wingless form of aphid which, in turn, lays eggs which form spruce-galls, whence issue lice in the original winged form. If the operations of the creature be confined to the spruce, its mischievous life-cycle is complete in these two generations—the winged and the wingless; but let some of the winged aphids alight upon a larch, and three generations are added to the life-cycle, the fifth and last being the only one in which there are any males, all the others being propagated by parthenogenesis. Their ravages on the larch are confined to the foliage, and it is strongly suspected by some biologists that it is through the wounds thus inflicted that the fungus *Dasyscypha calycina* often obtains access, and causes the fatal larch blister, which has cost planters in this country the loss of incalculable sums.

Far better and safer than the common spruce for underplanting are the giant cypress (*Thuja plicata*—appearing in nurserymen's lists as *T. gigantea*, *Lobbi* or *Menziesii*) and the Lawson cypress, both of which are valuable timber producers and endure a considerable amount of shade. Bulk for bulk, the Lawson cypress produces timber of finer quality than any other American conifer. Professor Sargent describes it as "light, hard, strong, very close grained, abounding in fragrant resin, durable, easily worked," and considers that, among all the rich variety of American forests, this tree and the Douglas fir are most worthy of the attention of British planters. Unluckily it has been most unfairly discredited in this country, owing to the facility with which, like all the Cypress family, it can be propagated by cuttings. Naturally a beautiful tree, carrying its fern-like foliage on short, slender branches and maintaining even in maturity a closely columnar habit of growth, it has disappointed many purchasers by developing multiple leaders and thickly crowded stems. The tendency to do so is not discernible in young plants; not until they are 12 or 14 years old does the planter realise that he has been served with stuff reared from cuttings, which can never get rid of the character of a branch stuck in the ground. In every case before planting any species of cypress a written guarantee

should be taken from the vendor that they have been grown from seed. A better security still is to grow one's own seedlings, which is easily and rapidly done at small cost, excellent seed being obtainable this year at 4*s.* 6*d.* per pound, which quantity should produce about 40,000 plants.

Having fixed upon one of the two alternative courses aforesaid for dealing with his old woodland, the owner should allow no æsthetic, sentimental, or other considerations to interfere with his resolution. If the ground is to be cleared, let it be done thoroughly. Should there be any notable tree, such as the Queen's beech at Ashridge, which it is desirable to preserve, let it form the centre of a shelter group to the young plantation; but beware of leaving such trees isolated in the general fall. Nothing but disappointment can follow upon doing so. Oaks, especially—and if there is a sylvan idol in any woodland it is pretty sure to be an oak or a beech—oaks, I say, are quite incapable of suffering the sudden removal of surrounding shelter. The chill of exposure is resented by an attempt to cloth the naked trunk and limbs which throw out a dense growth of twigs, known among woodmen as "rain-spray"; the sap is diverted by this effort from the extremities; the tree becomes stagheaded, and shrinks slowly to those picturesque but stunted forms that are so characteristic of the unenclosed parts of Sherwood Forest, or the still more pathetic cripples of Cadzow Forest. Risk of injury to the young plantation must also be taken into account, for a large tree thus isolated offers an easy target to the gale, and, in falling, will crush and destroy everything within its range.

In discussing the restoration of woodland to profit-yielding, the question of game preservation must by no means be left aside. An owner may well think a bird in hand worth two in the bush, and prefer the certainty of present sport, or rent in lieu thereof, to the prospect of long-deferred profit. It has been admitted above that the presence of ground game, especially rabbits, greatly impairs the productivity of woodland; further, that the old manner of cover-shooting, with the guns in line flooring wild pheasants as they were flushed by spaniels, could only be practised in open

woods with plenty of rough undergrowth. But modern cover-shooting depends upon totally different conditions, consisting of driving hand-reared birds skilfully towards a given point, and sending them, the higher the better, over guns posted forward. For such sport woodland under rotation is every whit as well fitted as rough covert. The floor of the older parts is bare, but pheasants will gather where they are fed, delighting in close canopy overhead. When disturbed they will run into the denser growth of young trees, where the rise may be arranged to take place. Any misgivings as to the effect of forestry upon pheasant shooting may be allayed by recollecting that the battue system is a fashion imported from Germany, where scientific forestry has been longer established than in any other country.—(*The Times.*)

OLD WORLD THEORIES *versus* NEW WORLD PRACTICES.

IS FORESTRY AS TAUGHT IN AMERICAN SCHOOLS OF PRACTICAL VALUE TO THIS NATION.

Forestry as a science has been practised in Europe for a much longer time than this continent has been known to civilized man. It is so old that some technical professors imagine it to have been perfected and cannot be in any way improved upon, while several very highly educated individuals, to whose names are appended a majority of the letters contained in the alphabet, shrink with horror at the suggestion of any innovation which does not emanate from Germany.

That trees exist in the United States which will grow without the aid of professional foresters and make various articles of commercial value during the life time of one individual is denied by their exotic professors upon every opportunity. Can we enlighten them?

There are vast differences in conditions which exist in Europe and in those which we find in America. Not only do soils, climate and flora differ, but many other features which control methods

and practices in these widely-separated continents vary, and so forest methods as practised in the foremost countries of Europe demand great modifications to suit American conditions.

Time has slight consideration where real estate is entailed, descending from father to son during many successive generations: expenditures are consequently made with the view of long time investments, which are not expected to benefit the lord who spends the money, and, perhaps, not the son who succeeds him, until a future generation, yet unborn, shall come into possession of the estate and harvest the crop.

Large areas belong to the crown and these are frequently maintained for the pleasure of the chase rather than for any economic values possessed by trees.

Density of population and cheapness of labour are ruling factors in European forestry, as this creates a demand for wood, even the faggots and every cast off branch and twig has a market value and ready sale.

Labour commands a much lower price than in the United States and can be employed with profit in forest methods which is prohibitory in the new world.

In America the removal of unmarketable logs, unsaleable trees, all branches and *debris* is at great expense with high-priced labour, while the abundance of fuel precludes the use of faggots even if transportations were not to be taken account of.

Scant population in rural localities of America and constant demand for labourers in agricultural pursuits tend to discourage all forest operations except such as are productive of lumber and materials which can quickly be converted into cash. The slowness with which a great majority of timber trees come to maturity, or with which they grow into saleable timbers, deters land-owners, from holding timber lands, and paying interest and taxes, for long periods without income. If to this must be added the salaries of high-priced technical managers, who must be retained so long as the timber remains in the immature state, it must of necessity prevent any large number of capitalists from maintaining forest properties.

Hence the retention of lands in common mixed forest, replanting with oak, hickory, yellow pine, and other long lived trees, and the study of the forests as a science with all the details of technique as it has long been practised in Germany, France and other European countries, cannot for many years become popular in the United States where the great problem for centuries has been to dispose of our surplus trees.

Europe has to a large extent exhausted her native forests and seeks wood from North America with three thousand miles ocean transportation besides transhipments from points in the interior, if shipments so originate.

While some other countries yet retain some timber, the greatest available supply is in North America and this is being rapidly reduced.

Thus the commercial demands for forest products urges the proprietors of great estates of Europe and the Government to maintain forests and plant trees. In the United States all lands are possessed by individuals and corporations who are liable to sell their realty when opportunity offers, so the incentive to plant trees, maintain the forests and study technical methods does not exist. Owners do not care to invest large sums of money in forest maintenance unless they can see some prospect of a return during their own lifetime. They do not care to plant trees, oaks, hickory or sequoias, which matûre only after centuries have passed.

With all this the theories of close planting and maintenance of groves in dense thickets, for the purpose of eliminating side branches and to form straight boles, which may be desirable with some trees in Europe, becomes totally impracticable in America where time counts so largely in men's affairs and where the interest consumes the principal while waiting for Nature to destroy enough trees that the fittest may survive.

Hair-splitting theories which are taught in American forestry schools are of slight importance to practical lumber men, and the technical youths who go out to instruct experienced and practical timber land-owners and lumber manufacturers are often laughed at for their impractical theories.—*(Arboriculture.)*

ORIGINAL ARTICLES.

THE USE OF TERMINALIA ARJUNA BARK FOR TANNING.

BY D. O. WITT, I.F.S.

Until I came to the Nimar division of the C. P. the use of the bark of *Terminalia Arjuna* (Kohar) as a tanning material was unknown to me.

That its use is far from general may be gathered from the fact that no mention of it is made in Watt's Dictionary of Economic Products, Vol. VI, Part 4, p. 16, nor in Brandis' Forest Flora of the North West and Central India, p. 225, though both authorities mention the bark as used medicinally.

Its use would therefore seem to be very restricted and hence of little importance and in calling attention to it, it is more with a view to point out a particular form of damage that may be caused to our forests by its use than to assist in further developing the industry. I will first give a brief sketch of the industry and the methods employed in the use of the bark. It is extensively used by chamars in the Nimar District for the tanning of hides and especially by the shoe-makers of Burhanpur, a fairly large community, where its use first came to my notice.

Removal and Collection of the Bark.—The bark is stripped from the trunk aud main branches during the months of April to June. The period of the year is an important point to which I shall refer later. This time of the year is chosen as the sap is then most active in the cambium layer and the bark separates more readily from the wood than when the flow of sap is at its lowest. I need hardly add the collectors strip off the entire bark, and are not in the least concerned with the immediate result, *viz.*, the death of the tree.

Treatment of the Bark.—The bark is then dried in the sun and pounded with mallets until reduced to shreds or as fine a consistency as possible. No further treatment is necessary. It is now ready for use, and is carefully stored away until required, great care being taken not to expose it to rain or damp.

Process of Tanning.—

I. Lime Treatment.—A fresh hide being taken, the inner side is well rubbed in with lime, tightly folded up, the inner side inside, and immersed in water contained in a broad-mouthed earthen pot or "nand" for ten to twelve days, the hide being kept pressed down with a heavy weight. During this period it is taken out every third or fourth day, well shaken, and again rubbed in with lime and put back in the "nand." About three seers of lime are rubbed into an average sized hide on each occasion. As many as four hides can be treated at the same time in this way. In place of the "nand" a pit two feet by two and half feet is some times dug in the ground for the same purpose. When the above process is complete the hide is taken out, well kneaded with the hands and the lime washed off with cold water. All shreds of meat that remain attached to the inner side are carefully removed with an instrument known as a "rapi," while the hair remaining attached to the skin is removed by scraping with a blunt iron blade (kulpi) worked with both hands. It is then once more washed with cold water.

II. Dyeing.—The next step is to give the hide the requisite colour. This is done by the aid of one or two dyeing materials, *viz.*, the young leaves of *Anogeissus latifolia* (dhaura) or the mature leaves and twigs of *Phyllanthus emblica* (aonla). The leaves of the "dhaura" are collected in the month of May when they are young and tender, and after being dried in the sun and pounded are ready for use. The "aonla" leaves and shoots on the other hand are collected in November and December when they are mature and tough. About four seers of the powdered "dhaura" or "aonla" leaves are put into a "nand" with cold water and well stirred in this solution, the hide is now immersed and left for from 6 to 8 hours. It is then taken out, wrung dry, and again immersed in a fresh solution. This process is continued every two or three days until the hide has assumed the required colour varying from a pale yellow to a light brown. The length of time required to give the requisite colour may be from three to nine days, according to circumstances. Sometimes both "dhaura" and "aonla" leaf solutions are used alternately.

III. Tanning.—The colour process being completed the hide is now ready to be tanned. The edges of the hide are brought together and stitched so as to form a sort of bhisti's "mashak" capable of holding liquid, and termed "adhurhi". It is then slung up to a post or tree and filled with water. Into this water is now thrown from 20 to 30 seers of the prepared Kohar bark. An earthen vessel is placed underneath to catch any liquid that may leak out, which liquid is from time to time poured back into the improvised "mashak" thus keeping it continually filled up. The object of this is to subject the entire skin to the action of the tanning material held within in solution. The skin remains thus for two days and on the third day it is inverted and left for another three days in this new position, while still full of the solution. In six days the process is complete, the solution is drained off, the stitches holding the sides together are cut away, and the skin now converted into leather, after being dried in the sun it is ready for use.

The above is a description of the ordinary process employed. It may however be varied by mixing with the Kohar bark "dhaura" and "aonla" leaves in the proportion of 2 of bark to 1 of leaves.

Source of Supply of the Raw Materials.—Having now described the process of using the bark I turn to the question of the raw material from the forests or wherever it may be available. The first point to draw attention to is the locality in which the Kohar tree (*Terminalia Arjuna*) is almost always found. In the C. P., I think it is safe to say that 95 per cent of the Kohar trees are to be found growing if not actually on the very bank of perennial streams and annual water-courses with half their root system exposed in the bed of the streams, yet seldom if ever more than 20 ft. from the edges of such streams. This peculiarity of the tree is very marked. However rich and moist the soil you will not find a Kohar tree, in this part of the country at any rate, far removed from a stream. The result as might be expected is that whether in forest or in open cultivated land, wherever a perennial stream flows or a stream that keeps pools of water in it here and there throughout the hot weather, the greater proportion of trees, say 75 per cent, growing

along such streams are Kohar trees. It follows then that all the supplies of this bark must be obtained from trees growing along the banks of streams and water-courses. As previously stated, the collectors of the bark are quite indifferent to the effect of their actions on the trees themselves, with the inevitable result that considerable numbers of Kohar trees are killed annually to supply the chamars with the bark they require for their tanning process. The death of these trees is further hastened by the period of the year chosen to remove the bark, *i.e.*, from April to June, when the hot scorching winds blowing at that season effectually debar the damaged trees from any chance of recovery. What is therefore happening is that streams and water courses are rapidly being denuded of the tree growth growing along their banks.

Influence of Tree Growth on Conserving Water Supply.—Now a great deal has been written lately in the *Indian Forester* and elsewhere on the subject of the influence of forests on water supply and rainfall, and not without reason.

I would specially mention "Notes on the Influence of Forest on the Storage and Regulation of the Water Supply" by Mr. S. Eardley-Wilmot, Inspector-General of Forests. (Forest Bulletin, No. 9). Not the least important point in this intensely interesting question is the influence of the growth in maintaining an equable flow of water in the streams and keeping up the "spring level" of the water in the subsoil. It is unnecessary to go into the arguments and reasons in support of these facts, they will be found fully explained in the literature referred to above, but they are incontestible facts. To put it shortly by preserving the tree growth along the banks of streams you (1) mitigate the violence of the rush of water in the streams during the rainy season, (2) prevent erosion of the banks, (3) maintain a more equable flow of water in the stream, and thereby (4) tend to lengthen out the period of flow; (5) assist in keeping the water in the subsoil at a higher level.

Conversely by destroying the tree growth along these streams you obtain the very opposite effect. That this effect is baneful in itself goes without saying, but, and I wish to emphasize this point, it is particularly harmful in the region to which I am referring.

Liability to Scarcity of Water in Regions where most Damage is done to Kohar trees.—In the Nimar District the rainfall is very scanty averaging about 30 inches, but varying from as little as 18 in. to over 50 in. The District is therefore peculiarily liable to scarcity of water. Now the tract where most damage is done to the Kohar trees, consists of hills of trap with the very poorest soil covering, large stretches of sheet rock being frequent. The tree growth on these hills is of the scantiest, consisting entirely of very open Salai (*Boswellia serrata*) forest. Along the base of these hills stretches a broad rich valley intersected by streams and water-courses fed by the rain of these hills. It is not so long ago that most of this valley was under forest. Now it is all given up to cotton cultivation, and practically the only trees left in it are such as have survived along the banks of the streams. Here the destruction of Kohar trees is going on apace. From the nature of the soil covering and tree growth on these hills it is clear that during the monsoon the proportion of rain running off and not absorbed, will be much greater than from more favourably constituted forests as regards soil covering and tree growth, while the rush of water in the streams at any particular moment of heavy rainfall will also be greater. Under these circumstances the value of the existing tree growth along the streams in the valley is considerably enhanced and it behoves us to maintain at all costs the maximum of such tree growth.

Quantity of Bark used annually in Nimar.—It is estimated that about 4,250 mds. of Kohar bark are annually used in the Nimar District for tanning purposes.

An actual experiment made to ascertain the quantity of bark obtained from a mature and average sized Kohar tree showed the green weight of the bark removed to be 47 seers. The weight of this after drying was 21 seers.

A reference to the "process of tanning" will show then, that the bark of one tree is not quite sufficient to tan one average sized hide.

Taking half a maund (20 seers) as the average quantity of dry bark obtained from one tree, and the total quantity of dry bark

used in the district in one year as 4,250 maunds, we arrive at the conclusion that no less than 8,500 Kohar trees are annually stripped of their bark, and, as all this bark comes from Malguzari and Ryotwari areas, the damage done must be very extensive even after making allowance for such trees as recover from the treatment they are subjected to.

Necessity for Restricting the Removal of Kohar Bark.—Either then the absolute prohibition of the barking of Kohar trees should be enforced or steps taken to reduce the damage done to the trees to a minimum. In Government forests extraction of the bark is entirely forbidden, but it is chiefly in the Malguzari and Ryotwari areas that the mischief is greatest. Under the rules applicable to waste areas in Malguzari villages, the felling of any tree growth within 20 yds. of a stream in which water ordinarily remains till the month of January is prohibited. There is nothing, however, in the rules forbidding the barking of trees with its inevitable result the speedy death of the tree. Orders have lately been issued by the Deputy Commissioner enjoining on all Malguzars the importance of maintaining as far as possible a permanent tree growth along streams and pointing out the damage done by the barking of Kohar trees and recommending that at least one-third of the bark on any Kohar tree should be left when barking the trees. It is questionable however whether the recommendation will be acted up to. It would therefore be preferable to absolutely forbid the removal of Kohar bark and the chief point in favour of this prohibition is that the use of Kohar bark is not absolutely indispensable to the preparation of leather.

Substitutes for Kohar Bark.—From enquiries made it has been ascertained that the tanning process can be carried out with the use of "dhaura" and "aonla" leaves only, and in certain parts of the district Kohar bark is seldom if ever used. It is said that Kohar bark used by itself produces a hard leather and that therefore leaves of "dhaura" and "aonla" are mixed with it. The bark of Saj (*Terminalia tomentosa*) is sometimes used in place of Kohar bark, but there are difficulties in its removal from the tree and hence it is not much in favour. The fruit of Ghatbor (*Zizyphus*

Xylopyrus) is also frequently made use of. It would appear that the use of Kohar bark is more a matter of habit than necessity. The chamars of Burhanpur tried very hard to get a reversal of the decision that no bark was to be extracted from Government forest, stating that their industry depended on the supply of this bark. Just about this time I had come across a number of bushes of Awli (*Cassia auriculata*) growing on waste land round the town. This species, as is well known, provides one of the best tanning materials and is largely used in the Madras Presidency, yet when asked about it the chamars of Burhanpur stated that they had never used it, and did not even know of its value as a tanning agent!

Cassia auriculata will grow equally well on dry stony soil and on black cotton soil and there seems no adequate reason why it should not be grown in sufficient quantities to supply the chamars of Burhanpur with all the tanning material they require. There are several waste patches within the municipal limits which are eminently suitable for the growth of *C. auriculata*, and, which, if planted, or sown up and properly managed, would in a very short time become a valuable source of revenue to the Municipality, besides supplying a cheap and excellent tanning material at the very doors of the chamars who require it. The first crop of bark is obtainable when the shrub is 5 years old, so that the initial cost of cultivation is by no means prohibitive.

Then, again, there is *Acacia arabica* (Babul) the bark of which furnishes an excellent tanning material. The Babul grows particularly well on black cotton soil, and as the valley at the entrance of which Burhanpur is situated, consists almost entirely of this soil, there would be no difficulty in growing this species. Tenants and ryots might be induced to plant their field boundaries and hedges with Babul and would always be sure of finding a market for the bark.

Cost of the Bark.—The chamars as a rule extract their own bark obtaining licenses from the Malguzars at the rate of Rs. 3 to 4 per cart-load of dried bark. This means an average royalty of 8 annas per maund.

Reasons for the Use of Kohar Bark.—The real explanation of the use of Kohar bark is that it is easy of extraction and has been obtainable in abundance and the idea of any restrictions on a custom of long standing is of course repugnant to the ideas of any native.

REVIEWS AND TRANSLATIONS.

THE WORLD'S BIRDS.

BY FRANK FINN, B.A., F.Z.S.

[Contributed.]

The number of books which have been written upon the birds of Great Britain and upon other local avi-faunas is legion. The present work is of much wider scope, being an attempt, and a very successful one, to survey concisely all the families of birds throughout the world.

Mr. Finn's extensive knowledge of birds, combined with remarkable powers of observation, assisted by an exceptional experience of zoological collections and museums have fitted him specially for the task he has set himself to perform.

The book commences with a very interesting and instructive introduction, in which the characteristics of birds and the phenomena of bird life are briefly reviewed. Following upon this all the families of birds are dealt with seriatim, in alphabetical order, the information under each family being classified under heads, an arrangement which will be found very useful for ready reference.

These heads commence with a short diagnosis of each family and include many interesting details which are often omitted in bird books, *e.g.*, period of incubation, courtship, flight, gait, note, disposition and habits, economic qualities, geographical distribution and important species.

Technical terms which might be unintelligible to the amateur are strictly avoided, and the sizes of birds are expressed as a rule by a comparison with familiar birds such as the sparrow, pigeon, turkey, etc.

The illustrations of which there are 51, all reproduced from photographs, are on the whole excellent.

The book undoubtedly fills a vacant space in bird literature and it will constitute a useful addition to the library of the student and naturalist.

CAUSE AND EFFECT OF THE GRADUAL DISAPPEARANCE OF FORESTS ON THE EARTH'S SURFACE.

[*Contributed.*]

Mr. Ducamp, a French Forest Officer of some 24 years' service, who has had considerable experience of forest management and mismanagement in various countries of the East, and who recently travelled in India in order to study certain questions of special forest interest, has an important article in the *Revue des Eaux et Forêts* for the 15th May last under the above title.

The author after certain preliminary statements as to the extent and nature of his investigations, and his title to speak with authority on the above subject, proceeds to state his conviction which has been gradually strengthened in the course of his investigations that the action of mankind which M. Blanc designates as accessory among the influences which have brought about the drying up of certain regions, is not an accessory, but the principal, cause. His second statement, which appears equally important, is to the effect that for any given diminution of the wooded surface or vegetable covering of the earth, whatever it may be, there is a corresponding diminution of atmospheric humidity.

In order to follow the phenomenon of the correlation of these two factors the author however states that it is necessary to adopt certain precautions. The question cannot be studied in restricted areas. Investigations should be extended to regions of sufficient geographic importance to show a distinct and well defined variation in climate from that of adjoining regions. As regards the action of men too, though the influence of the individual during the course of a lifetime may be infinitesimal, it is still to be reckoned with and it is to be remembered that such action is ever increasing and multiplying indefinitely. Even where duly recorded methodic observations are not available, there are still records and descriptions of countries as they appeared in the past which permit of useful comparisons being made.

The author then proceeds to discuss the question as to whether disforestation when effected over a given fraction of a definite

geographical zone or it may be the whole of a well defined area, such as the Central Plateau of France, the great plain of Russia, the Deccan of India, etc., is alone capable of bringing about such a diminution and irregularity in the rainfall that the annual water supply of the area becomes insufficient to support the normal growth of such vegetation as may remain.

The author states that this is the case and gives reasons for his deductions. Under the influence of the south-west monsoon which has varied but little in character, the coast of India towards Deesa (Bombay Presidency) no longer receives the amount of rain as it did in the past. Formerly the country was wooded and cultivated, to-day it is a desert which tends gradually to increase.

The above instance is quoted by the author who visited India in 1905 and who seems to have been very much impressed by the state of this portion of the Bombay Presidency. In addition to his own observations he states that by personal enquiry and the investigation of records, he satisfied himself of the incontestable relation which exists between the destruction of the forests and the diminution of the rainfall. The soil in the neighbourhood of Deesa is stated to receive less rain by about half than it did formerly—the rain cuts deeply into the soil, falling as it does with violence on its dry and pulverised surface, it does not penetrate but flows rapidly off into the streams in the form of mud. The work of destruction in this area though gradual has relatively extended rapidly over millions of acres (*vide* Ribbentrop, *Forestry of British India*, p. 33). Now there is no longer enough fodder even to support the flocks of goats, camels, etc., which aided by the action of man and fire have helped to bring about this state of affairs. It would be an interesting study, the writer surmises, to follow methodically in the Panch Mahals Division for example, the gradual deterioration of the teak. That this species reproduced itself naturally in the past is evident, as there are comparatively pure crops of it still existing, but at present it reproduces itself with difficulty or not at all.

The forests have been ruined, the author states, by grazing and fire. It freezes in winter and does not rain during the monsoon and the dryness of the air during the hot weather with its maxima

temperatures of 113°—122° is extreme. What is wrong with the climate it is asked? The south-west monsoon blows very much as usual so far as the mere current of air is concerned, but it does not bring the same amount of rain. What has changed is the state of the atmospheric moisture. This moisture has decreased partly owing to the increase of temperature (due to the heating of the uncovered soil) and partly to the diminution of the quantity of water evaporated from the soil. From these causes the saturation point falls to such an extent that condensation is retarded or even suppressed with the usual results in the way of scarcity and famine.

The wooded area is not sufficiently extensive to give that degree of evaporation which is wanting to complete the state of saturation to enable condensation to take place—which condensation is further retarded by the unfavourable temperature resulting from the destruction of the vegetable covering of the soil.

The final general drying up of the earth's surface may be an inevitable natural phenomenon but the cause of the general disappearance of vegetation from a given region is of a quite different order, and the author agrees with Professor Dumas de Huy that in nature when left to itself the effects of the phenomenon of the gradual drying up of the earth's surface would not be appreciable until the human race itself was about to disappear. The damage, such as one finds it, in definite areas is the work of man and from these centres it gradually extends indefinitely. The flow of the Nile is undergoing changes which necessitate recourse to dams, a temporary remedy which does not affect the initial cause. The shrinkage of the great African lakes due, like that of the Caspian sea and the sea of Aral, to diminished rainfall is the result of disforestation. The Congo is beginning to suffer from drought which is also extending to the Soudan, where the change in the rainfall has been clearly observed. If this irresponsible and foolish destruction of forest growth bears on what is already the minimum of forest necessary as in India, then the inconvenience of a diminished rainfall soon becomes felt and form the subject of enquiries as to what has happened to cause this change in the seasons.

In the case of the Niger at Timbuctoo it rains when it rains at all immediately over the river; at a little distance from its bank the precarious vegetation ceases to exist.

The writer then draws attention to the fact that under similar conditions evaporation from the open surface of water being represented by 1, evaporation from leaf surface is 60 and that for a given surface of 1, the leaf surface on that area may be at least 10 times as great. The water surface on the globe being 2·8 as compared with 1 of land surface, if we suppose ¼ of the land to be covered with forests, this gives $\frac{60 \times 10}{4} = 150$ of land evaporation as compared with $1 \times 2{\cdot}8$ of evaporation by seas, lakes, etc.

This enormous evaporation, which it is possible to reduce to a minimum by the destruction of the forest growth, is a very strong argument to bring against those who maintain that disforestation is only a minor cause and that changes in the rainfall are really caused by geographical phenomena not only in the Sahara but even in the whole of central Europe. Further argument might be drawn from Mr. de Lapparent's statement that the phenomena of the glacial period were produced not by exceptional cold but by very moist currents of air and the condensation brought about by mountain ranges. This large amount of atmospheric moisture was produced by evaporation from the ocean and from the immense forests which existed at that time and is doubtless the chief explanation of those rivers of which the dried up beds are now to be found in the Sahara.

The author concludes from the observation and deductions referred to in his article that on the borders of the Sahara as on the wooded fringe of the Indian desert or of the plateau of the Deccan for example and as on the Tonkin slopes towards China, the Russian, Trans-Caspian and Persian steppes and the coast of Somali land, the well marked gradual disappearance of forest growth is due to one and the same cause, *viz.*, the destruction of the forests by the axe, fire and grazing.

This destruction of forest growth on land suitable for cultivation is justified only up to a certain limit, when this limit is passed the humidity of the air decreases, the equilibrium is upset and

animal as well as vegetable life withdrawn, the forest brings the indispensable complement of the rest of creation.

This article of Mr. Ducamp's is of considerable interest and value. The subject is one not only of great interest but of immense practical importance.

The effect on the physical state of the earth's surface of the gradual disappearance of forest growth which is the natural covering of the land, is one which necessarily takes place so extremely slowly that it is very likely to escape observation, or, even when perceived, to have its importance undervalued.

Some recognition of the rôle that forests play in maintaining the water supply, and of the far-reaching evils that result from their destruction, has during the present generation dawned on mankind, and of late years has even found its way into the orders of the Government of India and the columns of the *Pioneer.*

In some of the more enlightened parts of India, the Government has actually taken steps to institute systematic series of observations to record the effect of disforestation on the water supply, and on the degree of moisture in atmosphere and in soil, with a view to check the destruction of forest growth in the catchment areas of the rivers upon which the irrigation systems mostly depend, and it is a matter of regret that in other Presidencies, the profound importance of this question (which will have to be faced some day, however much one may blind oneself now to it), has been overlooked, and subordinated to trivial and transient considerations of no real weight.

CURRENT LITERATURE.

THE BARK-BORING BEETLE ATTACK IN THE CONIFEROUS FORESTS IN THE SIMLA CATCHMENT AREA. (*Forest Pamphlet No. 2. Forest Zoology Series No.* 1.)—By E. P. Stebbing, F.L.S., F.Z.S., F.E.S., Imperial Forest Zoologist. The damage by insects in the forests of the Simla Catchment area were this year more severe than usual, apparently owing to the short rainfall of 1907-08. Mr. Stebbing identified two of the species which were attacking

the deodar saplings, as *Scolytus major* and *S. minor*. He also found *Polygraphus major*, which usually confines its attacks to the blue pine, also infesting the deodar. In addition a fourth beetle, belonging to the *Buprestidæ* was found attacking the deodar. The pamphlet details what is known of the life histories of these beetles, the damage committed by them, their natural enemies, and the measures proposed for combating these pests. Five plates accompany the text.

A GLOSSARY OF TECHNICAL TERMS FOR USE IN INDIAN FORESTRY. (*Forest Pamphlet No.* 3. *Working Plan Series No* 1.)—By A. M. F. Caccia, M.V.O., F.Z.S., Imperial Superintendent of Forest Working Plans. This glossary meets a long felt want and now it is to be hoped that forest terminology will gradually become systematized. We trust that throughout India, the terms given in this glossary will be used in the meaning ascribed to them, so that gradually the definite meanings laid down will become generally understood. The list is by no means exhaustive and we appeal to our readers to point out any omissions which they may notice, of forest terms in regular use, *e.g.*, '*Reserve*" meaning an area separately notified as Reserved Forest. If every one will help in this matter it will soon be possible for an exhaustive list to be compiled.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

NEW HIMALAYAN SEROWS.

Material in the Natural History branch of the British Museum, supplemented by living specimens in the establishment under his charge, has enabled Mr. R. I. Pocock, the energetic Superintendent of the Zoological Society's gardens in the Regent's Park, to determine the existence of four distinct races of serow in the Himalayan area, in place of the one hitherto recognised. The latter, it will be remembered, was regarded by the late Dr Blanford, as a distinct species, under the name of *Nemorhaedus bubalinus*,

although it was subsequently relegated by Mr. Lydekker to the rank of a race of the typical Sumatran species with the designation *N. sumatrensis bubalinus*. This view is accepted by Mr. Pocock, who proposes, however, to transfer the generic name *Nemorhaedus* to the gorals and to replace it in the case of the serows by *Capricornis*. Whatever may be the real rights of the matter it seems to us that no possible advantage can accrue from the proposed change, while an abundant crop of confusion may well arise, we shall continue therefore to follow in this respect the usage of Blanford and Lydekker.

The ordinary Himalayan serow, or as it may now be called the Nepalese serow (*N. sumatrensis bubalinus*) is characterised by the legs being dirty white below the knees and hocks, whereas in the typical Sumatran race, which is generally believed to extend into Burma, these parts are of the same rufous tint as the upper portion of the fore-legs and the thighs. Years ago, however, General Kinloch shot near Darjeeling a serow intermediate in this respect between the Sumatran and the Nepalese races; and of this intermediate type the British Museum possesses the mounted skin of a specimen from the same locality which lived for some time in the Duke of Bedford's Park at Woburn. Its intermediate character is shown by the fact that the lower segments of the legs are mingled rufous and white; the black coat of the upper parts being short, and the underparts blackish brown.

In the case of such an intermediate type two courses present themselves,—either to unite all three forms under a single name, or to give separate designations to each of them. Mr. Pocock has chosen the latter alternative, and if this view be accepted, the Darjeeling race will be known as *N. S. jamrachi*.

Next comes the Chāmba race *(N. S. rodoni)*, characterised by the long thick hair, supplemented by a coat of under fur, or *pashm*, and the white under-parts, lower segments of the legs, throat patch, and the space between the two branches of the lower jaw.

Still more distinct appears to be the Kashmiri race (*N. S. humei*), typified by a head presented in 1891 by Mr. A. O. Hume to the British Museum and characterised by its rufous brown colour,

exclusive, of course, of the usual white muzzle. The writer of this article has more than once thought of naming this head, but hesitated from a fear that its colour might be due to fading or to immaturity. Complete skins of this Kashmiri race would be most acceptable at the British Museum; and sportsmen should accordingly be on the look out for the animal during this shooting season.

In addition to these three new Himalayan races of serow, Mr. Pocock has described a fourth from the Selangor State, of the Malay Peninsula, which, according to the old nomenclature, will be known as (*N. S. robinsoni*). It is a black race, differing from the other black Malay race, *N. S. swettenhami*, by the practical absence of any red in the mane.

The discrimination of these various colour phases of the serow is well enough in its way, but unless it leads to something further we are not very much the forwarder. In this instance, however, it happens that there is a matter of wider interest; for in the serow we actually have a case of the evolution of a specialised black animal from the more generalised red type within the limitations of a single species; the only other analogous instance among ruminants that occur to us being that of the African buffalo, where the small Congo race represents the primitive red and the large Cape race the specialised black phase. Usually the development of blackness makes itself apparent at first only in the adult males, as in the well-known cases of the Indian black buck and the African white-eared kob; but in the serow, so far as we know at present, both sexes are either wholly red or wholly black, according to their respective races, or intermediate between the two.

The red type is represented by the Arakan race (*N. Sumatrensis rubidus*), which is believed to be a wholly rufous animal, although personally we have only seen the head. The Kashmiri race (*N. S. humei*) if wholly rufous brown, will be another representative of this red type. Intermediate types are represented by the Sumatran (*N. S. typicus*), Darjeeling (*N. S. jamrachi*), Nepalese (*N. S. bubalinus*) and Chamba (*N. S. rodoni*) races; while as examples of the black type may be cited the Malay *N. S. swettenhami* and *N. S. robinsoni*, together with the Anamese and

Tonkinese *N. S. marcolinus*. The latter, which was described by the late Pere Heude, seems, however, to be in a somewhat unstable condition as regards colouring : unless indeed the variations are to be explained by differences of age or sex. In all cases, however, the black seems to extend down the legs as far as the knees and hocks; but in some specimens of this race there is a certain amount of rufous mingled with the black of the upper parts ; while in others the coat is almost completely black, although there may be a few white hairs in the mane. The white maned serow (*N. araurochoetes*) of North-west China, which may be merely another race of the ordinary species, affords yet one more example of the intermediate type of colouring, the dark area of the body extending down to the knees in the four limbs, whereas the hind legs and thighs are wholly rufous.

As already mentioned, Mr. Pocock proposes to transfer the name *Nemorhaedus* to the gorals; but he also suggests an alteration in the names of the two Himalayan representatives (whether species or races is immaterial) of that group. By Blanford and Jordon the Himalayan goral (*Urotragus*, or *Cemas*, *goral*) was taken to be a brown animal, and consequently when Mr. Lydekker met with a grey representative of the group in that area, he naturally regarded it as new, giving it the name of *U. bedfordi*. Mr. Pocock is, however, of opinion that this grey goral was really the type of the original species, and accordingly proposes a new specific name —*hodgsoni*—for the brown animal. Nevertheless it appears to us that such a change is quite unnecessary, as it only throws matters into confusion without any resulting advantage. The brown goral has indeed been so long accepted as the representative of *Urotragus goral* that it may be said to have acquired an all sufficient title by length of occupation ; our own opinion in such matters that a "time-limit" ought always to be recognised after which no change is permissible. In conclusion it may be mentioned that Mr. A. E. Leatham, on his return from a shooting trip in the mountains of the Ichang district of Central China, sent to the Natural History branch of the British Museum for identification the mounted head of a goral from that district, which turned out to belong to a species never before seen in England. The general colour of the hair of

the upper surface of the head and neck is rich chocolate-brown, but the throat has a large patch of bright yellow. In most gorals this patch is white and extends to the chin. From this yellow throat-patch Mr. Leatham's animal is evidently identical with the *Kemas arnouxianus* of Pere Heude, described in 1888 in the well-known work on the mammals of China issued in parts at Shanghai, according to our nomenclature, the yellow-throated goral, as the species may be called, should stand as *Urotragus arnouxianus.* The colour of the throat-patch in this goral affords another instance of that marked tendency to the development of bright yellow and orange in the mammals of Tibet and the highlands of West and Central China.—(*The Indian Field.*)

ACQUISITION OF A HERD OF BISON BY THE GOVERNMENT OF CANADA.

It is satisfactory to learn that the Canadian Government has recently acquired a fine herd of some seven hundred bison, one of the few remnants of the countless numbers of these grand animals which roamed at will over a great part of the North American Continent a century ago. These were obtained by purchase from the owner, who had them on a large ranch in Montana. The ultimate destination of the herd is an area of 120,000 acres of wild land in Alberta, which will be inclosed by seventy miles of wire fencing 9 ft. high. Their transfer was a very difficult operation, for they were practically running wild in Montana, and to get them into the trains sixty men with 160 horses were engaged for six weeks. The existence of this large herd was certainly not generally known and its acquisition by the Government of the Dominion is said to have caused some disappointment in the United States where the negotiations for its purchase were not discovered till too late to avert the loss, for no doubt the Americans would have desired to increase their stock of bison in the Yellowstone Park. With the possession of so large a herd, however, established in commodious quarters and congenial surroundings, and free from molestation, the fear that this noble beast was doomed to extinction is finally set at rest.—(*The Field.*)

INDIAN WATTLE BARK.

"Wattle Bark" is the general name applied, both in commerce and the arts, to the barks of the various species of *Acacia* exploited within the tropics and elsewhere for the tannin which they contain. Over the arid sandy wastes that occur throughout the torrid regions of the globe, the thorny acacias instal themselves on the banks and beds of rivers and streams and shallow depressions such as admit of the temporary lodgment of water during the rains. In some situations during seasons of flood, they are frequently completely submerged for days, but recovering themselves from the depressing effects of the transitory deluge with seeming impunity, they flourish through the drier months of the year under conditions of climate untenable to all but very few species of broad-leaved trees. Indeed, the rigors of climate to which the zones that constitute the habitat of the acacias are subjected, may be gauged from the fact that some of the species are unable to develop ordinary leaves. The phyllodes, which take the place of the latter, are suitable modifications of the stem equipped to perform all the functions of the leaves they substitute. Although the foliar organs of most of the acacias are usually small and

seemingly delicate, the profusion in which they occur in the plant, their remarkable phyllotaxis or arrangement, and their incessant and vigorous activity throughout long and arduous periods of vegetation result in the formation, among the rest, of comparatively dense cortical layers surcharged with a variety of valuable substances of which the most important is tannin. When it is remembered that the tropical acacias form a large and well-distributed group of plants, it will be realized that the availability of tannin from this source alone is great indeed.

Nevertheless, it is a notorious fact that only a few species of the genus are exploited for the extraction of tannin. In India, again, with about eighteen species that are indigenous to the warmer parts of the country, the barks of *Acacia arabica*, Willd., and *Acacia Catechu*, Willd., are the only ones at present employed to any extent in the art of the tanner. Moreover, it must be further conceded that, so far from making the least attempt to commercially exploit the bark of the indigenous acacias, we have permitted ourselves, at considerable expense, to introduce four, and experiment with two, of the so-called wattle bark trees of Australia. Introduced on the Nilghiri Hills of Southern India in the early forties of the last century, these interesting and value able exotic acacias required no less than a period of thirty long years to become acclimatised and completely naturalized. And even though, as doubtless they do, the black and silver wattles of Australia (*Acacia decurrens*, Willd. and *Acacia dealbata*, Link) yield relatively large quantities of tannin of a quality which is inferior to none, not only in India but wherever else the factors of soil and climate have been found to adequately suit their several requirements, their adaptability and general excellence in themselves alone are circumstances which are unworthy to be advanced against the serious consideration of the neglect to which the local species have been now and always consigned.

In endeavouring to invite public attention to the immense possibilities that lie in the direction of the systematic exploitation of some of the commoner Indian acacias as sources of tannin, it must be mentioned that the moderate-sized, diffuse branching,

gregarious species, botanically known as the *Acacia arabica*, is certainly one of the most neglected but valuable. Although the quality of the bark of this acacia is inferior to that of the Australian wattles and even to that of the *Acacia Catechu*, the extent of distribution of the species in India and the numbers in which they occur there, are such as to warrant the conclusion that its systematic exploitation for tannin-extraction is likely to meet with favourable results by retrieving in quantity what it cannot in quality. The natural regeneration of the tree being easy but somewhat slow from seed, its artificial reproduction, for economic purposes, could be more successfully accomplished by the creation and development of shoots and suckers from the stool. For this the tree requires to be coppiced at suitable intervals, from time to time. The safest period, consistent with utility, of the economic exploitability of the species is said, on good authority, to be ten years, the age at which the bark has been found to be mature enough to contain tannin of sound and serviceable quality. At this age, too, the possibility is greater than at any other recently anterior one of obtaining an appreciable quantity (half a ton) of bark from each tree that will have been coppiced. With the yield of tannin at 15 per cent (actual experiment giving 18·95) a tree would produce 168 pounds of the substance at the close of the tenth year of its age. Thereafter, the yield, which improves with coppicing, would directly depend on the number, size, and vigor of the shoots which would be permitted to develop on the stool from those given out after each periodic felling. As regards the other Indian acacias, information of a realiable nature relating to the yield of tannin from the bark is at present unavailable. The important Khair (*Acacia Catechu*) itself is seldom looked upon as a source of tannin, outside the great and well known capacity of its wood as an yielder of catechu or catechu-tannin (catechin). No endeavour, beyond the local and, therefore, comparatively limited application of its bark as a tanning material, has as yet been made in India. To obtain the catechu the tree is felled and its heart-wood cut up into chips and boiled. The bark, however, with its stores of tannin, is usually left to rot on the ground. Some idea of the extent to

which this wastage of a useful and valuable raw material now takes place in the country may be gained from the fact that throughout the wide area of its distribution thousands of trees are annually felled. Why, when the wood is being boiled for catechu, or otherwise utilized throughout the country, the bark is not at the same time treated for the manufacture of an extract which assuredly contains a high percentage of tannin of good quality, is a question which so far appears to have been provocative of no reasonable or satisfactory response. The fact, at any rate, seems to savour of some of that sublimely supine indifference which the son of the soil has been proverbial for displaying in the treatment of a great and glorious heritage a mine of wealth whose superficial veins themselves still largely wait upon his consideration.

Besides the two indigenous acacias described above as sources of tannin, the undermentioned Indian species, too, deserve our best attention in India:—

(1) *Acacia Farnesiana*, Willd.—A low erect shrub or small tree occurring throughout the plains of India and Burma; it has bright yellow flowers that are fragrant and arranged in the axils of the leaves; it is armed with long straight spines.

(2) *Acacia ferruginea*, D.C.—A large deciduous tree with reddish brown bark; armed with short, hooked, double spines, the flowers occurring in axillary peduncled spikes.

(3) *Acacia Jacquemontii*, Benth.—A small elegant bushy shrub with smooth stem and straight, slender, shining spines; flowers like those of (1).

(4) *Acacia Latronum*, Willd.—A small tree or shrub of Southern India, occurring in gregarious thickets; its flowers are given out in numerous spikes from the nodes of the branches when the tree is leafless; the double spines are long and straight.

(5) *Acacia planifrons*, W. and A.—A species similar to (4) in habit and distribution, but with grey lenticels in place of spines. (4) and (5) form flattened tops that are very conspicuous and remarkably typical of the dry open forests in which they occur.

(6) *Acacia leucophlœa*, Willd.—A large deciduous tree with short straight white spines; flowers in small heads borne on long terminal tomentose panicles.

(7) *Acacia modesta*, Wall.—A small tree with short, hooked, double spines and small sparse, greenish yellow spikes of flowers.

(8) *Acacia Suma*, Kurz.—A moderate-sized tree with glabrous bark and tomentose branchlets, hooked double spines, and yellowish white flowers.

(9) *Acacia Sundra*, D.C.—A large tree resembling *Acacia Catechu* but with dark brown branches and no pubescence.—(By A. M. S. in *Capital.*)

AFFORESTATION IN IRELAND.

The question of afforestation in Ireland was discussed in the House of Commons on the 21st May 1908, on the vote for the expenses of the Department of Agriculture and Technical Instruction. Mr. T. W. Russell said that "when he came into office the country was being rapidly denuded of timber. The landlords who had not sold their land were cutting down the timber and turning it into cash, tenants who had bought, not realising the value of the timber, were cutting it down and selling it, and the Estate Commissioners when they sold an estate had to sell the timber, and the only market for it was the timber merchant. He appointed a departmental committee, which had reported in six months, so there had been no delay. The question was urgent because if nothing was now done the opportunity would to a large extent pass away. The other day two estates were purchased by the Estates Commissioners, one with woods valued at £5,000, and the other with woods valued at £4,000. The Estates Commissioners had to dispose of those woods, and they would have been sold to the timber merchant if the Department had not stepped in and purchased those woods under the trustee clause of the Land Act. But the Department had not the funds with which to do that all over the country, and unless something was done the Estates

Commissioners must sell to the timber merchant. Moreover, the land suitable for planting was being sold, and if they did not get it now, they would have to pay a great deal more for it, even if they could get it at all. There never was a case for State intervention on a public issue so completely demonstrated as this. It meant a modest expenditure to begin with—as an investment and not as expenditure—and he had therefore appealed strongly to the Treasury, who had given him the necessary money to set up a Committee, and he would plead with them not to let that money be thrown away."

* * * * *

It is understood that Mr. T. W. Russell has practically secured £10,000 from the Government to cover the cost of afforestation in Ireland. The department have already acquired the woods in two districts through the Estates Commissioners—one at Dundrum and the other at Camolin, co. Wexford.

The County Kildare Agricultural Committee had under discussion recently the question of giving trees gratis for the planting of one acre to farmers and others who would undertake to provide proper fencing for the young trees and look after them in an adequate manner.

The chairman said the only encouragement they had yet given was to supply the trees at cost price and giving advice on the matter. It occurred to him that in certain cases, where occupiers of land undertook to plant a certain quantity of land (say, for example, an acre), to fence and clear that plot, they might go so far in such cases as to give the trees free. He thought that when they had saw mills in the country, a ready market, and if trees are doing in the mind of the occupier a certain amount of injury to his land, he did not see why they should so far interfere with his rights to cut down and sell the timber. The only way they could prevent denudation of the land was by having, if possible, more trees planted than have been cut down. He did not think there was any use in growing hedgerows.—*(Timber Trades Journal.)*

THE FORESTS OF ASIA MINOR.

The trees of which the forests of Asia Minor are composed are the fir, pine, cypress, cedar, juniper, birch, chestnut, oak, plane, poplar, linden, beech, elm, ash, and willow. The old forests have disappeared, and the tendency of nature to prepare the soil for a second growth is being continually defeated. As no industry has ever laid claims, to any great extent at least, upon the forests of Asia Minor, their disappearance can be attributed only to the demand for fuel. Fir and pine forests now exist only on the high plateaux, or mountain ranges, such as the Paphlagonian Mountain range, which is situated towards the shores of the Black Sea. In this district the rainfall is greater each year than in the vilayet of Smyrna. Beech, plane and elm trees also thrive in the valleys and plains. In Armenia there are large forests of red beech, walnut, oak, and chestnut. The American Consul at Smyrna says that there are reported to be forests of large beech trees in the country at the back of Trebizond, at some distance from the coast, and in the Ak Dagh Mountains. It is also said that there are forests of tall pines not far from Angora. Between Smyrna and Konia there are no forests of importance. The willow tree which grows well in some parts of the country, especially near Angora, is, to some extent, protected from the inhabitants on account of the shade it affords in summer, and because it grows rapidly, and is supposed to act as a preventive against fever. The whip-like branches are often woven into bee-hives. The poplar is frequently found in large groves scattered about the country-side, and is used chiefly in constructing houses in the Turkish villages. The oriental plane tree is found all over Asia Minor, but seldom in groves. They usually stand alone along the roads, and serve the traveller as half-way stations, where he finds some protection from the summer sun. These trees also add considerably to the scenery of the country. They grow to be several hundred years old, and often attain such size that shepherds have been known to cut huts in the trunks of the standing trees, and their vitality is so great that they continue to live for years afterwards. The plane is also a favourite shade tree. Smyrna has none, but Constantinople and

the little villages leading away from the Bosphorus, as well as most cities and villages in the interior, have large numbers of them. The Turks are fond of having them in front of their cafés, and in the yards of their mosques. The oriental cypress is a stately tree, which grows to exceptional size in Turkey, and especially along the coast of Asia Minor. It is revered by the people, and is planted in groves in every Turkish cemetery. These trees are an ornament to the country, and no Turkish landscape is complete without them. In the old Cemetery of Smyrna the grove is several hundred years old. In various parts of the vilayet of Smyrna a certain kind of scrub oak flourishes, upon the leaves of which a gall wasp lays its eggs. These eggs become secreted in the cells of the plant, and after a time form excrescences the size of a berry, called gall-nuts, from which a winged insect makes its way out and escapes. The nuts are green and white in colour, and some 3,000 to 4,000 sacks are shipped to England, Germany and Austria every year. Some gall-nuts are exported to America for the purpose of making ink, but only small quantities are shipped from the port of Smyrna. In the opinion of experts the quality of the timber in Asia Minor is good. The State reserves to itself the control of the forests at all times, but there does not appear to be any regularised system of forestry, with the exception of a few experiment stations. The peasants are permitted to chop and burn freely. A Government permit is necessary only in case timber is to be exported. The owner of some forests near the headwaters of the Boli Su River, who holds a permit to export timber, has given the following description of the manner in which timber is obtained in that district. Along most of the rivers which flow into the Black Sea there are many primitive saw mills, only a few of which are equipped with steam engines. The logs are dragged down the mountain side by horses and oxen and rafted down the Boli Su to the mills, where they are sawn into lumber for shipment to Constantinople or other parts of Turkey. Nomad tribes who in winter house themselves and their flocks in timber huts have done much harm to the forests of Asia Minor, especially in the vilayet of Smyrna. In order to obtain the necessary logs or

poles for building their huts, they help themselves to any unprotected timber in the neighbourhood. The disappearance of the forests, especially in the vilayet of Smyrna, has been marked by greater degrees of heat and cold. The date palm has practically become extinct here. In the winter and spring there are usually floods, which are destructive to life, property and crops. In the summer there is not sufficient moisture in the soil of many districts for the reason that the rain passes away at once down woodless ravines without being absorbed by the ground. As a result large tracts have become sterile. Crop failures and famines in Asia Minor may therefore be traced to the lack of forests. The demand for timber of every description in Smyrna may be stated as follows :—Boxes and cases for the fig and raisin industry ; hardwood for flooring ; mahogany and walnut for furniture and cabinet-making, picture frames and wood ornaments. There are a few saw mills in Smyrna which make a business of sawing and planing imported timber into the sizes desired by the local trade.—*(Journal of the Society of Arts.)*

FELLING TREES BY ELECTRICITY.

The question of felling trees by other means than the axe has for a long time occupied the attention of saw mill engineers. Reciprocating saws driven by steam have been in limited use for many years, and answer fairly well in easy situations and where the trees are regular, but in hilly and difficult positions, owing to the constant moving of the steam plant necessary, they have not proved always commercially successful.

To get rid of this difficulty many attempts have been made. In one case electricity was used to heat a copper wire to a white heat, and this was made to practically burn through the trunk of the tree, but, owing chiefly to the accumulation of carbon, resin, etc., on the heated wire, it has hitherto proved a commercial failure.

Recently, however, horizontal reciprocating saws driven by electric motors have been used for tree felling, we believe with

very great success. In this case electric power can be generated at any desired point and carried by means of wires to any place in a wood or hillside that may be necessary with very little loss. The tree-feller usually consists of a horizontal reciprocating saw arranged with a long stroke, and working in suitable guides, the working parts being made light but very strong, so as to be capable of being readily moved from tree to tree.

The saw is driven from a crankshaft, but, in lieu of fast and loose pulleys, an electric motor is coupled directly to the shaft and speeded down to the correct number of revolutions. The form of motor employed should be designed to give a high output with as light a weight as possible. For this purpose a four-pole type of motor, with slotted drum armature, is often used.

In addition to rapidity of work, a tree-feller has a great advantage over the axe in being capable of cutting the tree close to the ground and thus saving a considerable amount of timber and, at the same time, in many cases it saves the cost of blasting the stumps.

As regards the cost of electric power for this particular work, it will pay well in most cases to generate it by steam, but, of course, where water power is available, it should be made use of, as an immense economy is at once effected, and the current can be carried any reasonable distance without much loss.

Where many trees have to be felled, especially in isolated and difficult situations, we now look for considerable development in this connection.—(*M. P. B., in the Timber Trades Journal.*)

RE-AFFORESTATION IN FRANCE.

The following extract from the *Scientific American, Supplement,* dated 18th July 1908, giving an account of the establishment of protective forests in France is instructive. The work, it is estimated, will cost £10,000,000. It would be well if we in India were to realize the danger we incur by our present indifference to this important subject :—

"The great achievement of France in forestry has been the establishment of protective forests where much destruction had been

caused by floods and winds. From various causes large areas were cleared of forests toward the close of the eighteenth century, and only when it was too late was it realised that these lands were not fit for agriculture and should have been left in forest. To repair the mistake, a movement to reforest began in the nineteenth century. It was an exceedingly expensive mistake. Down to the present time, encouraged by wise laws, the State, the communes and private landowners have restored to forest over 2,500,000 acres, and so saved them from ruin. In addition, the resulting forests return an excellent revenue. Two-thirds of the torrents of Europe are in France. In the Alps, the Cevennes, and the Pyrenees mountains there are 1,462 brooks and mountain streams which are considered dangerous. Nearly a million acres of mountain slopes are exposed to erosion by these streams, to say nothing of the flat land below. As far back as the sixteenth century there were local restrictions against clearing mountain sides, enforced by fines, confiscation, and corporal punishment. In the main these prevented ruinous stripping of hill sides, but with the French Revolution these restrictions were swept aside and the mountains were cleared at such a rate that disastrous effects were felt within ten years. By 1803 the people had become aroused to the folly of this cutting. Where useful brooks had been, there now rushed torrents which flooded the fertile fields and covered them with sterile soil washed down from the mountains. The clearing continued unchecked until some 800,000 acres of farm land had been ruined or seriously injured, and the population of eighteen departments had been reduced to poverty and forced to emigrate. By 1860 the State took up the problem, but in such a way that the burden of expense for reforestation was thrown upon the mountaineers, who, moreover, were deprived of much pasturage Complaints naturally arose. An attempt was made to check torrents by sodding instead of by forest planting. This, however, proved a failure, and recourse was again had to planting, by the law of 1882, which provides that the State shall bear the costs. Since then the excellent results of planting have completely changed public sentiment. The mountaineers are most eager to have the

work go on and are ready to offer their land for nothing to the Forest Department. In addition to lands secured by gift, the State acquires 25,000 or 30,000 acres a year. Over 500,000 acres have been acquired and more than one-half of this area has been planted. Already 163 of the torrents have been entirely controlled and 654 are beginning to show the controlling effects of the forest of their watersheds. Thirty-one of the torrents now entirely controlled were considered hopelessly bad half a century ago. It is expected that 50,000,000 dollars will have been spent before the work of reforesting for protection is complete."

A NEW RUBBER TREE.

Rubber or caoutchouc is now known to occur in a great number of plants, and it does not appear as though the heat of the tropics is necessary for its development, nor that it is the produce only of large trees, for we have already in cultivation a tree (*Eucommia ulmoides*) from Northern China which yields rubber, and is evidently as hardy as the British elm, and Ecanda rubber from Angola is the produce of a small turnip-like plant. Guayule rubber is obtained from heather-like bushes, which cover large areas in Mexico, and vine rubbers are yielded by a family of climbers, the landolphias. It has been stated that a very large number of plants reveal in their latex traces of rubber, but only those that contain it in sufficient quantity and of the right quality to pay commercially are of economic interest. The discovery of a new rubber tree in Tonkin was recently recorded by Dr. T. Eberhardt, Director of Forests, etc., of Indo-China, in the *Bulletin Economique.* This tree is known to the natives as Teo-non, and has been named by botanists *Bleekrodea tonkinensis.* It belongs to the same natural order as the mulberry and fig (Moraceæ), and is therefore related to the Assam rubber tree (*Ficus elastica*) and the Central American rubber tree (*Castilloa elastica*). It occurs all over the province of Bac-kan, and in the southern parts of the Circles of Bao-lanc and Cao-bang, preferring hilly ground and strong fertile soil, but disliking clay. It grows quickly, and

forms a tree from 40 ft. to 50 ft. high, freely branched, the bark whitish; the leaves are variable in shape, more or less lanceolate and dentate, from 2 in. to 6 in. long, and 1 in. to 1½in. wide; the flowers, which are small and unattractive, are borne in axillary cymes; the fruit is a small berry, and contains one seed. The trees are tapped at the base, and there is a copious flow of latex, which is collected in cups formed of bamboo joints, and then placed in water heated to boiling point, the rubber thus forming into cakes. The latex is collected twice a year; one before, the other towards the end of the rainy season. From a tree 8 in. in diameter tapped in May Dr. Eberhardt obtained 480 grammes of latex, and he thinks that in the autumn such a tree would yield about 650 grammes. An expert in rubber reported that the Teo-non is equal in quality to Para, and practically indistinguishable from it. A cake of Teo-non exhibited at the Colonial Exhibition held in Marseilles in 1906 was awarded a gold medal. The climatic conditions most suitable for *Bleekrodea* are presumably tropical, as young plants are in cultivation in the Botanic Gardens at Hanoi, in Tonquin. Should it prove as easy to manage as its allies, *Castilloa* and *Ficus*, there will be no difficulty in establishing plantations of it in tropical countries generally, and if the rubber is, as has been reported, abundant and of quality equal to Para rubber, there is sure to be a brisk demand for seeds and plants of it.—(*The Field.*)

VOLUME XXXIV NUMBER 11

INDIAN FORESTER

NOVEMBER, 1908.

FOREST RESEARCH IN INDIA.

For many years past, the need of a central Research Institute to enquire systematically into all subjects and sciences connected with Forestry and to publish the results of such enquiries was *keenly felt*. In 1906 the Imperial Forest Research Institute was founded in order to meet this want. To start with, Government were not, we believe, prepared to sanction six special officers for this work alone, and consequently advantage was taken of the five posts already held by Imperial Forest Officers at the Imperial Forest School, Dehra Dun. Only one new Imperial post was added, and this together with the five posts already in existence was allotted for the staff of the new Imperial Forest Research Institute. The staff thus formed, however, was not freed from lecturing work, and it was arranged that in addition to research work they should give lectures at the Imperial Forest College which was at the same time formed out of the Forest School at Dehra Dun. The Imperial Forest specialists at the Research Institute thus have a great deal of their time taken up with duties connected with the College and it seems to us impossible for these specialists under present

conditions to do a great deal of research work, without the co-operation of the remainder of the Department.

The present system of obtaining aid from the officers of the Department is by means of circulars which are often sent round to every one through Conservators. Now our experience is that officers receiving circulars asking them to investigate and report on all sorts of subjects in addition to their ordinary work, which is often extremely heavy, have their interest killed at the outset. The result is that the replies received to such circulars frequently tend to be superficial and unsatisfactory. Would it not, we would like to ask, be better to find out which branches of research individual officers are interested in or incline towards and to try and obtain their co-operation in these subjects? If this plan were adopted we believe that the Imperial specialists would shortly have interested workers in each province to assist them, and their research work would progress more quickly. Such an arrangement would tend to create understudies for each post, so that when any post at the Research Institute became vacant there would be several candidates to select from, and in addition it would be a step towards the formation of Provincial Research Institutes which we trust will come in time.

Research work is one which every keen Forest Officer wishes to see advance, and cohesion in the Department is the most ready means to this end. The Research Officers and Conservators could soon find out what subjects the officers in each province are most interested in and would doubtless find little difficulty in enlisting their aid in those subjects. In the same way Divisional Forest Officers might induce their Provincial Officers and Rangers to make investigations and observations in subjects towards which their inclinations tend.

We by no means wish to advocate that every Forest Officer should become a specialist, but if in addition to his ordinary work he has to help in Forest Research work which he must do if research work is to progress as it should do, we believe the way to do it is by interesting individuals in individual subjects rather than by sending circulars on all subjects to all officers and risk

the possibility, if not probability, of making them disinclined to give any real assistance.

The Forest Association recently proposed to extend its scope to the investigation of professional subjects, but this was negatived by the majority of its members. However, the Association being non-official might do an immense amount towards furthering research work, by assisting and inducing individuals to take up special subjects. If each Forest Officer would take the subject most congenial to him the Imperial specialists would soon have correspondents in each province interested in their subject to assist them in their investigations by making enquiries and studying their subjects locally. In this way, the results of the Imperial Forest Research Institute would be more marked, and we believe they would soon be great enough, not only to justify the separation of the Research Institute from the College in order that the specialists should have more time to devote to research, but also to warrant the formation of Provincial Research Institutes as well.

SCIENTIFIC PAPERS.

INDIAN FAMINES AND INDIAN FORESTS.

Every one who has made any sort of impartial study of, or enquiry into, the causes of the disastrous famines with which various parts of our Indian Empire are so frequently cursed and blighted, agrees that they are due to one cause alone, the failure of rainfall. This is a physical cause arising from the influence of the strength or weakness of aerial currents, the south-west and north-east monsoon winds; and the greater or less amount of rainfall that these winds bring depends entirely on conditions existing outside of India, and beyond the control of either the Indian Government or the Indian people. India always has been, and still is, mainly an agricultural country. Out of its total population nearly two-thirds, or about two hundred million souls, are dependent on agriculture for a livelihood; while the holdings

are usually small, and the cultivated area is only a little over one acre per head of the total population. And in many parts agriculture is carried on under extremely uncertain and precarious conditions as to the natural supply of a sufficient amount of soil-moisture being provided by these otherwise fairly regular monsoon winds. The south-west or summer monsoon, after sweeping, saturated with moisture, across the Indian Ocean, generally bursts over Burma in May and over India in June and this marks the beginning of the agricultural year, following two to three months of intense heat, during which the bare earth has been scorched and torrified under the fierce glare of a blazing sun in a brazen, cloudless sky, which bakes the soil hard and makes it sterile through lack of moisture.

As soon as the thirsty land gets sufficiently softened by rainfall ploughing begins, and during the next two to four months before the monsoon ceases, in September or October, or later in Burma, the various crops of millets and rice are grown for the autumn harvest, the more important for the food-supply of the people. The choice between these two main classes of crops depends chiefly on the local average amount of rainfall; in each case, however, successful agriculture depends not only on the total amount of the rainfall, but also on its favourable distribution. Heavy rains flood the low-lying tracts while deficient rainfall and long breaks in between good showers cause drought on the higher lands. In October the ploughing and sowing for the spring harvest begins, which includes wheat, barley, and pulses, among foodstuffs in the north, and millets in the south; and these crops are dependent on the north-east or winter monsoon rains, which break late in November or early in December along the Madras coast and about Christmas in the other parts of India which they affect.

As the result of these climatic conditions, governed by circumstances entirely beyond human control, the vast territory of the Indian Empire, about 1,100,000 square miles in area, is naturally parcelled out into more or less well defined zones of average annual rainfall, which determine the character of the agricultural

crops that can be raised. The coasts of Bombay and Burma, upon which the south-west monsoon winds first impinge and deposit much of their moisture, and the cool, thickly wooded mountain tracts in the north-east of Bengal and in Assam have an annual average rainfall of over 100 inches. In the immediate vicinity of these three zones of heaviest rainfall, and extending all along the base of the Himalayas and throughout the deltas of the Ganges and the Brahmaputra in the Bengals, and the plains of the lower Irrawaddy, the Sittang, and the Lower Salwin in Burma, there is average rainfall varying from fifty to a hundred inches ; and in these areas rice cultivation can be carried on with this natural water-supply. Fringing this belt of ample rainfall along the Himalayas and including the whole of Oudh, then stretching north-west only as a thinner belt, but reaching down to the Ganges delta, and thence extending over the whole of the rest of Bengal proper, the Central Provinces, most of the Central Indian States, and northern part of Madras, comes the zone of thirty to fifty inches whose north-western limit forms roughly a convex arc drawn from Baroda, at the head of the Gulf of Cambay, to not far above Allahabad, where the Jumna effects its junction with the Ganges, while its north-western limit describes a very sinuous line from the Tapti river to the mouth of the Kishna. In the rest of Southern India, comprising the Deccan and the greater part of Madras, the average rainfall varies between ten and thirty inches and beyond the north-eastern limit similar averages obtain for the greater part of the United Provinces, the south-eastern Rajputana States, and the Panjab, while the Thar or Rajputana desert to the west of Bikanir and all the lower Indus valley and westwards across Beluchistan form an arid zone having under ten inches of rainfall. A large part of Central Burma forms a zone of thirty to fifty inches while the core of the province forming the middle of the old kingdom of Ava has even less than that.

So far as variations from the normal average rainfall are concerned, the tracts blessed with fifty inches or above are much more likely to suffer from inundation than from drought; but

throughout the whole of the rest of India and that means over about four-fifths of the total area, or nearly 875,000 square miles there is always, except in irrigated tracts, a greater or less danger of a weak monsoon current failing to bring sufficient rainfall to satisfy the minima requirements for successful agriculture.

Naturally, too, the highest average temperatures occur in the arid tracts, the climax being attained in the Rajputana desert, which falls within the high isothermal of 90° Fahr. Another result of this widely differing rainfall is the extreme variation in the distribution and the character of the remaining woodlands, which still cover 250,000 square miles or nearly one-fourth of the total area of India. In wet zones having a fall of over 75 inches evergreen tree forests prevail; in the tracts with from about 30 to 75 inches the quasi-evergreen and purely deciduous forests vary greatly according to rainfall, elevation, soil, configuration, etc., while in the dry and the arid tracts with less than 30 inches the vegetation is usually scanty and more or less scrub-like.

As has been briefly indicated above, any irregularity or weakness in the rain-bringing monsoon currents, and especially in the great south-western monsoon which profoundly affects the whole of India except the eastern portion of Madras, is bound to influence the agricultural crops to a greater or less extent wherever their thriving is dependent solely on rainfall. Whenever any considerable irregularity occurs, and more particularly when there is a shortage of rain, crop failure and consequent scarcity are bound to be the direct and immediate results. And this not only affects the landowners and the tenant occupiers, but also the poorest labouring classes who work in the fields for hire, as then there is less work for them. But even when there is a scarcity this does not necessarily mean that famine is about to ensue. Extremely thrifty as a rule, the Indian peasant can generally survive with admirable equanimity the loss of one bad season; and by means of the good railway-net, food grain can now be easily poured into tracts where scarcity is announced. But not being a capitalist and the individual holdings being usually small, his credit with the local money-lenders soon shrinks when a harvest fails. And

when, as is unfortunately now so very often the case, there has been a succession of years of drought, then the resources of the patient and resigned Indian peasant soon become exhausted, and famine appears with all its horrible sufferings and their terrible after-effects in the shape of epidemic diseases. On their crops failing the poorer agricultural classes first try to eke out a scanty livelihood by gathering and eating wild fruits and roots in any neighbouring jungles, and it is only when the hard pressure of actual want becomes keenly felt that they can bring themselves to quit their fields and go to the test works opened by Government for famine relief. And so strongly is the Indian peasant bound to his ancestral holding by caste and by all that he believes in, that he absolutely declines to remove from his habitual surroundings to other parts of his province, or other parts of the Empire, where vacant land is still easily obtainable in fertile regions well provided with water either naturally or artificially supplied.

In former times when the Mahrattas and Pindaris laid waste and terrorised the whole of Central India throughout the eighteenth century, and down to the time when the entire empire came under British rule, matters were much worse than they now are, when so much has been done to improve the old systems of water-storage in tanks, and to provide abundant water perennially by vast irrigation canals. But while oppressive misrule and war have been put an end to, the blessings of peace have to a very serious extent aggravated the difficulty needing so often to be dealt with. The suppression of female infanticide, the maintenance of peace, the saving of life by such means as hospitals, improved sanitation, endeavours to restrict and overcome epidemic diseases, and famine relief on a vast scale during outbreaks of famine have all tended to increase the population very largely. And as this increase is not being balanced by a proportionate industrial development throughout the Indian Empire, or by emigration from congested districts with precarious rainfall to non-congested provinces, like Assam and Burma, with abundance of vacant virgin soil and unfailing rainfall, it simply means that whenever or wherever

irregularity or shortage of rainfall is apt to produce scarcity there is all the greater danger now of this becoming a famine.

The greatest and as yet the only means of artificially providing soil-moisture is irrigation, of course ; and the enquiries made by the Irrigation Commission of 1901-03 showed that, with its total population of nearly 300,000,000 about 53,000,000 acres, equal to 17·6 per cent were ordinarily irrigated out of the total cultivated area of about 300,000,000 acres. *And of these irrigation methods* canals supplied 19,000,000 acres, wells 16,000,000, tanks 10,000,000 and other sources 8,000,000. For British India alone, with its population of about 220,000,000, and an average area of 226,000,000 acres, annually cultivated, the area ordinarily irrigated was 44,000,000 acres, or 19·5 per cent.; *and of these irrigated lands* 18,500,000 acres were watered from State and 25,500,000 from private irrigation works. The areas thus protected against climatic shortcomings, and secured as regards a sufficient water-supply for agriculture by means of irrigation, are mainly those which lie within the operation of the large canal systems of the Northern Indian rivers and the deltas of the Madras rivers, and those which can be amply supplied with water from wells. But outside of these artificially protected areas and of the tracts with an assured rainfall there must always be a recurring danger of scarcity through insufficient natural moisture, and a consequent risk of famine ; and this means that by far the largest part of India is continually exposed to this danger, the most frequently afflicted parts being the great Deccan plateau, forming the central portion of the peninsula of Southern India, and the adjoining portion of the Central Provinces and the Central Indian States, although Western-Bengal and Orissa, the United Provinces and the Punjab have more than once been the scene of very severe famines, and are now again thus afflicted.

In olden times transport was primitive, and when famine occurred the people just wandered and died. Thus in 1769-70 when famine afflicted Bengal, the loss of life was estimated at 10,000,000. Without reckoning years merely of greater or less scarcity, parts of Madras have throughout the last 150 years been visited by eight famines, extending over 18 years ; and it was in

connection with a scarcity which threatened to become a famine there that relief works were first opened by the British in 1792, although the obligation to provide relief for all who sought aid was not recognised till over 40 years later, during a severe famine in and around Agra and Delhi in 1838, when a fixed famine wage was given (£230,000 being thus spent). But regular relief works under professional control were not brought into operation till the great Bellary (Madras) famine in 1854.

It was not until after British India had passed under Crown government, however, that anything in the shape of a famine policy was considered. Agra and Delhi having again, along with Rajputana, in 1860-61 suffered from famine extending over 53,000 square miles, with a population of 20,000,000, a special inquiry, the first of the kind ordered by Government, was carried out by Colonel Baird Smith, which showed that stability of tenure and canal irrigation had already improved the people's power of endurance. And when land-locked Orissa and Bihar in Bengal and the Bellary and Ganjam districts of Madras were in 1865-67 blighted with a famine affecting 180,000 square miles with a population of 47,500,000, and severe scarcity also extended all along the south-eastern coast and into the Bombay Deccan and Central and Western Bengal, a Commission of investigation was appointed under Sir George Campbell, which effectually aroused the attention of Government to the responsibilities resting upon them.

From this time may be dated the humane modern relief-policy which has been gradually developed during the last forty years, and which has now become so far perfected as to be a great safeguard in preventing serious loss of human life, *though it does not in the very slightest degree attempt to improve the local conditions as to climate and soil-moisture, except where irrigation is practicable in areas lying lower than the beds of the great rivers at the points where these can be utilised as sources of water-supply.*

Almost immediately thereafter the great famine on the eastern side of the peninsula was followed by another equally severe famine on the western side, affecting 296,000 square miles with a population of 44,500,000 and centring in Ajmer and Rajputana, also a

land-locked area. It was during this famine that Sir William Muir, Lieutenant-Governor of the North-Western Provinces, issued his oft-quoted order that "every district officer would be held personally responsible that no deaths occurred from starvation which could have been avoided by any exertion or arrangement on his part or that of his subordinates," in spite of which the mortality was high, owing to the great immigration that took place into British territory from the Native States.

When the next famine broke out in 1873-74, affecting 54,000 square miles in Bihar with a population of 21,500,000, the vast expenditure of £6,750,000 was incurred in somewhat indiscriminate gratuitous relief. Two years later another Southern Indian famine occurred, in 1876-78, which in its second year included not only Madras, Mysore, Hyderabad, and part of Bombay, but also extended into the Central and the United Provinces and the Punjab, affecting a total area of 257,000 square miles with a population of 58,500,000. Sir Richard Temple was then sent down as Famine Commissioner to assist the Madras Government and to ensure that suitable precautions should be taken against such reckless expenditure as had been incurred in Bihar. Relief administration was much stricter, and a famine wage of one pound of grain plus one anna per man (known as 'the Temple wage') was fixed, but was afterwards found to be insufficient except under favourable conditions. And though these measures cost about £8,000,000, yet the extra famine mortality in British territory alone was estimated at 5,250,000.

While Madras and Bombay were still suffering from this famine that began in 1876, and then extended to the United Provinces and the Punjab in 1877-78, modern relief policy became definitely outlined by the Secretary of State's declaration in 1877 that 'the object of saving life is undoubtedly paramount to all other considerations. But it is essential that . . . . you are bound to adopt precautions . . . . similar, so far as the circumstances of India permit, to those with which in this country it has always been found necessary to protect the distribution of public relief from abuse.' This was the key-note struck when the appointment of the

first Famine Commission was ordered in the despatch of the 10th of January 1878, 'to collect with the utmost care all information which may assist future administrations in the task of limiting the range or mitigating the intensity of these calamities.'

This first Famine Commission was appointed on the 16th of May 1878 with General (afterwards Sir Richard) Strachey as President, and it submitted its long report on the 31st of July 1880. If there was any previous doubt about the matter, it established beyond further question the fact that all *Indian famines are caused by drought* and '*that Indian famines are necessarily recurring calamities, against which such precautions as are possible must be taken beforehand, and that it is the duty of the Government to do its utmost in devising some means of protecting the country, and to persevere in its attempts till some solution of the problem has been obtained.*' It therefore recommended the adoption of 'a definite system of procedure, to be embodied in a famine code and urged the importance of improved meteorological observations and the dissemination of the useful information thus obtainable in advance.' These recommendations were embodied in a provisional Famine Code, which was circulated in 1883, and under which Provincial Codes were drawn up for future guidance and action.

Among the questions on which the Commission's opinion was asked was one concerning the influence which the denudation of forest may have upon the rainfall and on the subsequent retention of the rain-water in the soil, and its effect on the permanence of springs or flowing streams. This was, in point of fact, the renewal of a very important question which had been brought before the notice of the Government thirty years previously. In 1846 Dr. Gibson, then acting as Conservator of Forests in Bombay, had pointed out the serious effects that were already ensuing from extensive clearance of woodlands during the previous fifty years. He had, in a letter, dated the 9th of March 1846, clearly stated that unrestrained clearances had diminished the fertility of neighbouring gardens and rice-lands, and of the surrounding tracts generally, and that if continued they must necessarily have the disadvantageous effect of considerably increasing the mean annual temperature and

the aridity of the climate. As proof of this he showed that since extensive clearances of forest had been made in the South Konkan, the people asserted that the springs had dried on the uplands, and that the climate had become much drier, the seasons more uncertain, and the land less fertile. This and other similar representations led the Court of Directors to send out a despatch (No. 21, dated the 7th of July 1847) asking the Government of India to ascertain 'the effect of trees on the climate and productiveness of a country, and the results of extensive clearances of timber.' The Government of India at once took action; but the times were troublous, and only three reports from Madras Collectorates were published. These gave valuable evidence about the drying up of springs after forest clearance and the effect of this on water storage at the base of hills, the rapidity of forest denudation since the introduction of railways, the injurious effects of extensive clearance on climate and soil-fertility, and the assertion of the cultivators in Trichinopoly that where the forests had been cleared the heat and wind were much increased, and that dry cultivation had extended greatly owing to a diminished water-supply in the tanks and wells. Among scientific bodies at home, too, the forestal question in India was arousing serious attention, and in 1851 the British Association appointed a committee to consider the probable effects, from both economical and physical points of view, of the destruction of forests; and this committee reported urging forest conservancy and planting operations.

No definite reply was ever officially given to the very important questions raised in that despatch of 1847. But this matter had now again come before the Government of India in Sir Richard Temple's report on the Madras famine of 1877, in which he said:—

> We cannot but reflect whether the uncertainty of season, which often proves so disastrous in Southern India, is not becoming worse and worse; whether there may not be some physical causes at work to render the rainfall precarious; and whether such causes can be ascertained and obviated. It is hard to conceive a question more practically important than this. The discussion of it would be beyond the scope of this minute. But, connected with it, there is one particular matter which may be mentioned forcibly, though briefly. The Southern Peninsula of India has been or is being denuded.

not only of its forests but also of its jungles, its groves, its brushwood, its trees. The denudation has been, as I understand, going on near the sources and in the upper courses of the many rivers which water the country. This, perhaps, is being in some degree checked. But with the progress of coffee-planting, and with assertion of commercial rights on behalf of the people, the utmost vigilance will be needed to keep it within bounds. If it were to proceed unchecked, there would be imminent danger of the rivers running dry. · · · · And, as these rivers supply the great canal systems, this danger has only to be mentioned in order to be felt. The same argument applies in a lesser degree to the tanks or lakes, which are second only to the canals in usefulness for irrigation. It has already been seen how precarious is the question of these reservoirs, even with one year's drought. In the midst of cultivated tracts there are to be seen bare, sterile hill-sides said to have been forest-clad within living memory. In such localities the climate is supposed to have been changed for the worse. Beyond the Ghat mountains, in Bellary and Kurnool, the treeless, shrubless aspect of the country is as wonderful as it is melancholy. These are the very districts where famine has been occasionally epidemic and where scarcity has been almost endemic.

This subject was therefore referred to the Famine Commission in 1878, and the results of their investigations are contained in three pages (177-79) dealing with 'Forest Conservancy' (*Report*, part ii, chap. vi, sec. ii), which may be summarised as follows so far as they bear on the particular points at issue :—

1. · · · · Whether the presence or absence of forest has any direct effect on precipitating rain is a much disputed point, which we shall not attempt to decide ; but there is before us a great amount of evidence from all parts of India that the destruction of forests is believed to have acted injuriously by allowing the rain waters to run off too rapidly. They descend from the hill-sides in furious torrents, which carry down the soil, cause land-slips, and form sandy deposits in the plains, so that the surface drainage, which, if gently and evenly distributed over an absorbent soil protected by vegetation, should furnish a perennial supply of fertilising springs passes rapidly away, and the streams into which it collects quickly cease to flow, after causing mischief instead of good. · · · ·

2. The action of the State, which certainly was too long deferred, has everywhere been much hampered. · · · ·

7. · · · · but the Indian Forest Act of 1878 has at length given the Executive ample powers to arrest further waste and denudation, and to administer the forest resources to the greatest public advantage.

9. · · · · *We think it probable that some of the least productive tracts now under the plough might be managed with greater benefit to the community as protected forest for village uses than as arable land.*

10. So far as any immediate advantage is to be sought from the extension of forest in respect to protection against drought, it will, in our opinion, be mainly in the direction of the judicious enclosure and protection of tracts · · · · from which

improved and more certain pasture may be secured for the cattle of the vicinity, a supply of firewood secured which may be led to a more general utilisation of animal manure for agriculture, and a possible addition made to the power of the subsoil to retain its moisture, and to the prospect of maintaining the supply of water in the wells. · · · · As to the protection of the higher hill-slopes from denudation, it may confidently be stated that they will, in any case, be more useful if kept clothed with wood than subjected to the wasteful and destructive process by which they are brought under partial and temporary cultivation, and that, whether the expectation of an improved water-supply as a consequence of such protection is fully realised or not, there is on other grounds sufficient reason for arranging for the conservation of such tracts where it is practicable.

In the main portion of the Commission's report, however, no reference whatever was made to forests, and the Forest Department is not even mentioned in that part of it (para. 120) which urges the "co-operation of all departments · · · apart from demands arising in relation to direct measures of relief."

Further light was thrown on this most important subject when Dr. J. A. Voelcker, Consulting Chemist to the Royal Agricultural Society, was sent out in 1892 to study and advise on agricultural matters, and embodied his opinions in a *Report on the Improvement of Indian Agriculture*, 1893. In the chapters dealing with 'Climate' and 'Wood' he made very valuable observations concerning the relation between agriculture and forests; and he gave proper appreciation to the work of the Forest Department, which was even then still accursed in the eyes of many district officers. With regard to woodlands he said :—

38. · · · I would point out that their real influence and value consist in their *lowering the temperature*, and thus causing moisture to be deposited where it would otherwise pass on. · · · · Thus, a given quantity of rain will be distributed over a greater number of days, and its value to the agriculturist will be thereby largely increased. · · · · Though immense tracts of country have been denuded in the past, there are still considerable areas which can be taken up and rendered serviceable for climatic ends, and the Forest Department has stepped in none too early in the endeavour to save those wooded tracts which are still left. From climatic considerations alone the work of the Forest Department is, accordingly, of importance. · · · ·

180. *Having instanced sufficiently the need of more firewood for agricultural purposes, I must now express my concurrence with the views that have been expressed both by Governments and by individuals, that the way in which the supply of wood to agriculture can be best increased is by the creation of new enclosures for the purpose of growing wood, scrub jungle, and grass.* Such enclosures are now denominated 'Fuel and Fodder Reserves.'

182. The question was often asked by me, why the Forest Department has not created more 'Fuel and Fodder Reserves.' . . . . Undoubtedly progress is hampered by an insufficient staff, but I consider this important question must not be longer delayed.

197. *Such 'reserves' should be primarily adapted to serve agricultural ends. There is a considerable amount of land which might be taken up for this purpose, in others land must be purchased. The results must not be gauged by financial considerations alone, but by the benefits conferred on the agricultural population, the keeping up of the soil's fertility, and the maintaining of the Land Revenue to the State.* Enquiry is needed in order to ascertain exactly what the requirements of each district are in respect of fuel, etc., and how these may be met. Continued encouragement should be given to the spread of arboriculture. *The Forest Department is certainly undermanned, and the present financial check placed upon its further development in an agricultural direction should be removed.*

The first fruits of Dr. Voelcker's report appeared in a Government of India resolution in October 1894, when it was formally declared that '*the sole object with which State forests are administered is the public benefit*'; and this has been the policy adopted since then. Very soon thereafter a striking example of the direct utility of forests in providing edible roots and fruits and fuel for the relief of the labouring poor, and of the advantages obtainable in granting them free collection of grass for their starving cattle, occurred in 1894 during serious scarcity in parts of the Central Provinces. 'Nothing that was done for the relief of the people', the resolution thereon stated, 'is said to have been more appreciated than the concession made in this respect.'

The first severe test to which the Famine Codes were put came in 1896. In the Bundelkhand district of the United Provinces the summer rainfall of 1895 was scanty and the winter rains failed, and relief works were begun early in 1896. The monsoon of 1896 was also weak, and famine soon spread over between a quarter and one-third of all India. The whole of Central India was famine stricken, together with parts of Madras, Bombay, the Punjab, Bengal and Upper Burma, the afflicted areas aggregating about 307,000 square miles with a total population of 69,500,000 of whom 4,000,000 had to be given relief whilst the famine was at its height. Never before had famine relief operations been so extensive. Over 820,000,000 units received relief at a cost of nearly £6,000,000,

besides large remissions of revenue and loans afterwards made for the purchase of plough cattle. But in British districts alone the famine mortality was about 750,000 before the autumn harvest of 1897 ended the general distress, which was followed by an exceptionally heavy death-rate from fever and other epidemic diseases always following in the wake of famine.

As soon as this great distress was ended a second Famine Commission, of which Sir James Lyall was President, was appointed on the 23rd of December 1897, to examine and compare the various systems of relief adopted locally and the results attained, and 'to make enquiries and record any recommendations or opinions which it is thought will prove useful in the case of future famines.' Under the Provincial Famine Codes special arrangements had been made for the withdrawal of restrictions tending to exclude persons in distress from the full benefits of the natural products of the Reserved Forests or waste land containing an important supply of edible produce and also for the protection of cattle when the pasture was about to fail by sending them to the nearest Reserves that could be opened and by supplying them with fodder and water on the way there. The only direct mention made on the forests in this Commission's report, dated the 20th of October 1898, is with regard to Bombay where—

141. The operations undertaken by the Forest Department with the object of supplying the distressed districts with grass, cut and compressed in the more favoured parts of the Presidency, constituted an important departure from the prescriptions of the local famine code, which are confined to measures for throwing open the forests for free grazing and the collection of edible products. Effect was given to these measures both in the distressed tracts and in adjoining districts. But in the distressed areas the drought affected equally the forests, and the agriculturists refused to send their cattle to distant forests. The fodder operations involved a net loss . . . . but it is claimed that many valuable cattle have thereby been kept alive and that the results of the experiment will be of great use in future droughts.

Similar evidence had just before then been published in the Madras Relief Fund Committee's report for 1897 (vol. ii, p. 373).

The solution which promised the hopes of best success . . . . consisted in throwing open to free grazing all the forests in the Ceded districts . . . . (*i.e.* of the Deccan, where the cattle numbered about three million, and where the forests area exceeded 3,810,000 acres, much of which was, owing to its altitude exempt from the parched condition of the

plains and lower hills) . . . . The proposal was . . . . to induce the ryots to club their cattle into herds under appointed drovers, who should take the cattle into the reserves under supervision of Revenue Inspectors, and keep them there till better times came. This plan was in accordance with old native custom, and believed to be by far the best. Under a sky of brass a wind like scorching fire was sweeping over the Deccan, and the fate of its cattle—all but the large stall-fed bullocks of the richer ryots—depended upon the promptitude with which the herds were rescued. . . . . The second requisite was the opening of every forest reserve for free grazing. These reserves cover an area . . . . capable of carrying a million head of cattle. . . . . All the ordinary herds could be driven to these reserves. . . . . The reserves were at last all opened towards the end of May. And nearly 700,000 head of cattle benefited thereby.*

Hardly had the Commission reported, however, before another and even a more widespread and serious famine broke out. Beginning in Ajmer in 1898, it spread all around in 1899, affecting an area of 475,000 square miles and a population of 59,500,000, of whom 6,500,000 were receiving relief in July 1900, while the total number of units relieved exceeded 1,140 millions. It was at once the most widespread and the most terrible famine that had ever occurred in India and over £7,000,000 were spent in Government relief measures.

To enquire into this a third Famine Commission was appointed on the 20th of December 1900, with Sir Antony MacDonnell as president. So far as forests were concerned, its report, dated the 8th of May 1901, drew serious attention to the exceptionally high mortality of far over four million cattle which had been a marked feature of this famine.

205. The great mortality of cattle in the recent famine has pushed to the front the question of their preservation in times of drought and dearth of fodder. Such fodder famines are fortunately rare. In an ordinary famine, when the crops fail at the late stage of their growth, there usually remain sufficient straw and grass to save, at any rate, the useful cattle ; but the recent famine has been abnormal in this respect. It is estimated that nearly two million cattle, local and immigrant combined, died in the Central Provinces and its Feudatory States, and that an equal number died in Bombay. The mortality was also great in Berar and Ajmer, in which latter district no effective measures were taken to prevent it. . . . . In their efforts to save their cattle, the Gujarat agriculturists expended all their savings, themselves enduring great privations ; they sold

* *Madras Famine Report*, 1898, vol. i., p. 37.

their jewels and even the doors and rafters of their houses, we are told, in order to purchase fodder. Their efforts failed, their cattle died, and with their cattle all their accumulated wealth disappeared, so that Gujarat became a stricken field.

206. . . . . In the Central Provinces, where the conditions were very favourable to success, well considered and sustained action was taken by the authorities. The free cutting of grass was allowed ; the means of watering were provided, as far as possible ; forests were thrown wholly open to grazing and grass was given away in large quantities. The Province had, in fact, as a whole, more than sufficient fodder for its requirements, and exported large quantities both of grass and jawari straw. And yet the cattle died in immense numbers.

207. . . . . In Bombay relief measures were conducted on a scale hitherto unknown . . . . but the conditions were such . . . . that no efforts . . . . could achieve more than a partial success.

Regarding the deportation of cattle to the forests this Commission did not think it advisable to put pressure on the people, as in Gujarat and Berar large numbers of stall-fed cattle thus deported had died on the way, while 'the coarseness of the grass, the change of water, or, again, the scantiness and insufficiency of the water-supply, as well as the neglect of the hirelings in charge, are fatal to carefully reared and stall-fed beasts.' But, they added: '216. We think, nevertheless, that the forests should be opened to all who are prepared to take the risks.'

In the second Famine Commission's report of 1898 there was one very ominous sentence (para. 404): '*Viewed as a whole we consider that . . . . the areas over which intense and severe distress prevailed in the famine of* 1896-97 *were greater than in any previous famines.*' And yet the next famine, immediately thereafter, was still more widespread and distressing. Now, this very sad and serious state of affairs is hardly to be wondered at. Ever-widening areas of scarcity must become the rule, unless far more is done than has ever yet been attempted to afforest all waste lands and the poorest classes of agricultural soil, and to plant and manage them solely for the benefit of the surrounding agricultural population and their plough cattle.

During the fifty years previous to the assumption of Government by the Crown there were four famines and four periods of scarcity ; and during these last fifty years since then there have been twelve great famines, including the two most extensive and

disastrous that have ever occurred, and six periods of serious scarcity. Indeed, within the last ten years there have been three great famines, and serious scarcity has now become almost an annual occurrence in some part or another; while the famine of 1907-08, that has for over a year been blighting Upper and Central India, has already proved of long duration and great extent. Now there can be no doubt that the previously existing relations between woodlands and waste jungle-covered tracts on the one hand, and cleared agricultural land on the other, have been greatly disturbed and entirely altered during the last sixty years since the Court of Directors' despatch was sent out in 1847. Whatever beneficial effects, extensive wooded or shrub covered areas can possibly exert on the temperature and the relative humidity of the air, and on the temperature and the amount of moisture retainable within the soil, the sum total of such benefits must necessarily have become greatly diminished through the vast clearances made for permanent and temporary cultivation under British rule during many years of peaceful occupation and of rapidly increasing population, railway development, and trade. During the last fifty years under Crown government the agricultural situation in high-lying tracts has, despite the benefits of extensive irrigation in tracts lying lower than where the great river-courses can be tapped, become aggravated by an increase in population certainly exceeding 60,000,000 and probably amounting to 80 or 100,000,000 souls, and by correspondingly vast clearances of lands formerly covered with trees or shrubs; and these clearances for cultivation must inevitably have simultaneously decreased the capacity of the soil for retaining moisture and increased actual aridity of both the soil and the atmosphere. So far, therefore, as any sort of opinion is justifiable in default of a careful scientific enquiry, it may be presumed that these extensive clearances of woodlands and the pressure of a population of 300,000,000 now requiring to be supported must inevitably have tended both to induce and to prolong the now more frequently recurring periods of scarcity, and also to increase the danger of scarcity becoming famine.

Although the Reserved and Protected Forests amount to nearly 25 per cent. of the total area of India, yet the percentage of their distribution varies enormously (Burma 75, Assam 45, Central Provinces and Berar 21, Madras 13½, Bombay 12, Bengal and Punjab 9, United Provinces 4, Baluchistan and North-West Frontier 2); and this means that in the hottest and driest parts and in the most densely populated Provinces, where woodlands and scrub jungles would afford the greatest benefits to agriculturists and their cattle, the forests now exist only in an inverse proportion to the need for them.

I have before touched incidentally on this matter in an article on 'The Forests of India' (see the *Nineteenth Century*, February 1907), but I would here plead for more attention, a more specialised scientific and specially botanical enquiry, and more money being devoted both to the consideration of and also to actual experiments connected with the question as to whether or not the Government cannot do something to relieve the situation by (1) afforesting all still existing waste lands and also acquiring many of the lowest grade cultivated lands, which are the first to become affected by and last to recover from the effects of drought, and (2) by endeavouring so to plant or sow them with any sort of trees, bushes, coarse grasses, or even desert plants as can possibly be made to grow there.

Thirty years ago the Secretary of State (despatch of the 10th of January 1878, para. 9) said: 'It is of still more essential importance to ascertain how far it is possible for Government, by its action, to diminish the severity of famines, or to place the people in a better condition for enduring them.' Never yet, however, has science been properly asked except to a partial extent through Dr. Voelcker in 1892, to aid in ameliorating in such manner the lot of the patient agriculturist and of his dumb, helpless cattle. The Famine Commissions of 1898 and 1901 were enquiries by practical administrators, and only considered forests as the means of possibly providing edible roots and fruits, and grazing for cattle in time of scarcity. And the Indian Irrigation Commission of 1901-03 did not investigate the influence of forests on rainfall and

water storage. Nor is the Agricultural Department in a proper position to make the searching investigation and the authoritative recommendations that seem called for.

I would emphasise what Dr. Voelcker said in 1893 (op. cit. p. 159) :—

It is very clear from the instances I have given, that there is good deal of land on which 'fuel and fodder reserves' might beformed and if only systematic enquiry be made, it will result in showing that there is very much more land available than has been stated. In almost every district (in the North-West Provinces) there are uncultivated spots among existing cultivation which would grow *babul* or similar wood perfectly well.

And, in addition to trees, bushes, and grasses indigenous to India, experiments should also be made with the flora of the drier tropical and sub-tropical parts of Africa, America, Australia. Here science can and should aid India, and it rests with Government to take the necessary steps to obtain such assistance. The results would, of course, not be of immediate benefit, but the necessities of future generations call for the immediate commencement of experiments to try and ameliorate *even to a small extent* the existing precarious conditions.

Far be it from any intention to say anything that may be taken to imply that little or nothing has been done in the directions indicated by Dr. Voelcker (see p. 155); but I do urge that nothing adequate has yet been done, and that much has been left undone which might well find even its financial justification in the splendid and ever-increasing annual revenue accruing from the work of the Indian Forest Department. Even now there are great possibilities of doing much good in this direction. The uncultivated areas are still in many parts very extensive, and these waste lands receive *little or no attention from Government.* And although the Forest Department was considerably strengthened in 1907, yet it is still undermanned considering all the extra work it ought to be called upon to do in the interests of Indian agriculture, and of the patient, uncomplaining millions engaged in the toilsome and exceedingly precarious cultivation of the soil throughout by far the greater portion of our Indian Empire.

Even in Burma, the best wooded and one of the best watered of all the provinces, with its 75 per cent. of woodlands and its thin

population, the results of disturbance of the water-supply have already been recently felt so strongly as to have necessitated active measures being taken to restrict and regulate hill clearances And if that be the case there, then it is certain that the others parts of India need measures going very much further.

No Secretary of State for India could be more sympathetic than Lord Morley or more willing to consider informal representations made regarding matters concerning the welfare of Indian agriculture. After his famous first budget speech on the 20th of July 1906, in which he highly eulogised the work of the Forest Department, his attention was drawn to the fact that no proper reply had ever been given to the despatch of 1847, and that possibly such an enquiry as would now be necessary to probe this economic sore to the bottom may probably show that the afforestation and improvement of waste tracts for the partial amelioration of agricultural conditions in future might well be considered a fit object towards which to devote a fair share of the splendid surplus annually accruing to the provincial and imperial treasures from the forests of India. Preliminary action has already been taken in so far that a circular has been issued by the Government of India calling upon the Provincial Governments to enquire and report upon the influence of woodlands and scrub-covered jungles on climate, soil-moisture, water-storage and agriculture and simultaneously therewith, in *Notes on the Influence of Forests on the Storage and Regulation of the Water Supply* (Forest Bulletin No. 9, August 1906), Mr. Eardley-Wilmot, Inspector-General of Forests, has touched on this matter as regards some of the drier parts of India. But he could not possibly deal fully with the subject, and what is needed is a thorough scientific enquiry.

When these reports are published they will form the first ful and complete official answer to the question asked by the Court of Directors in 1847. But they will then only be merely a preliminary enquiry ; for it is not to administrative and executive officers, but to scientific specialists that Government must look for that particular kind of aid that Indian agriculture has long stood so much in need of.—(By J. Nisbet in *the Nineteenth Century and After.*)

ORIGINAL ARTICLES.

FIRE PROTECTION ON THE TICKET-PATROL SYSTEM.*

BY DHANJISHAH NASARWANJI AVASIA, C.P.F.S.

The Allapilli teak forests are situated in the Ahiri Range of the South Chanda Division about 70 miles to the south of Chanda and about 350 miles to the north-west of Rajamandri along the Godavery and the Pranhita rivers, the latter river being about 8 miles to the west of the forests.

2. The area of the forests is roughly 73 square miles, of which about $\frac{2}{5}$, consisting of irregular high forest of teak mixed with miscellaneous species and bamboos called Working Circle No. I, has been under the provisions of a working plan for the last 12 years; the system in force being the selection system combined with improvement fellings. The rest of the block having a growing stock of young teak mixed with other species, is called Working Circle No. II, and is worked under a system of improvement fellings.

3. The climate is very dry with an average rainfall of about 46 inches per annum, and the maximum day temperature in the shade in the hottest part of the summer, which lasts there from the end of February to about the 15th of June, is 115° to 118° F.

4. The prevailing rock is metamorphic and mostly granitoid, with masses of felspar and quartz in places. The resulting soil is a rich light loam, which is favourable to the growth of teak.

5. The forests are surrounded for miles by the waste lands and forests of Ahiri zamindari, in which a few small villages of wild tribes are dotted about at long distances. These villagers have ample grazing land for their cattle and forest produce for their household requirements in the zamindari forests. The Forest Department forests are therefore not at all burdened by any concessions and are entirely closed to grazing. The only

* As carried out in the Allapilli Teak Forests of the South Chanda Division, Southern Circle, C. P.

and the greatest, danger to them is from the forest fires which annually scour the zamindari forests all around the Reserve for days together from the end of March to about the 15th of April.

6. Fire protection was therefore undertaken immediately on the purchase of these forests from the Zamindar and has been in force in Working Circle I for the past 30 years, and in Working Circle II for over 20 years.

The external fire-lines are all boundaries of the Reserve and are 50 feet wide. In places where the growth of grass is very tall and heavy in the adjacent zamindari forests, the grass on the zamindari side for a width of about 50 feet is pressed down so that it may burn easily at the time of counter-firing the zamindari forests. The internal lines are boundaries of blocks, cart-roads, and crests of ridges, and are 50 to 100 feet wide. There are smaller lines within the Reserve which are cleared to a width of 6 to 10 feet, and are used as inspection paths. These may be used as bases for counter-firing in case of a fire occurring within the Reserve. These lines are entirely cleared of all tree growth. The area in question is divided into blocks of about 20 to 30 square miles, each of which is in charge of either a Forester or a Senior Forest-guard.

Temporary huts, called *nakas*, are constructed on the lines for the housing of the fire watchers at a distance of about 3 to 5 miles from one another. These watchers are necessary for the effective sweeping of dead leaves on the lines and the controlling of the traffic on the roads passing through the forests. The huts consist of light wooden platforms of poles raised about 20 feet above the ground, supported on 4 long posts buried in the ground, and having light grass roofs, the whole being strong enough to support two fire-watchers and occasionally a Forester and his servant sleeping on them.

Temporary wells are dug in the *nalas*, close to the *nakas*, and are repaired annually either at small cost by hired labour, or by the watchers themselves as soon as they are entertained.

7. It is difficult to say exactly what the original cost of the work was, but judging from the nature and amount of the work

and the rate of wages paid to labourers in those parts, the original work could not have cost more than Rs. 100 per square mile, allowing—

Rs.	80	for the cutting	of	100 ft.	lines per mile.
"	50	do.	do	50 ft.	do.
"	8 to 10	do.		10 ft.	do.

" 10 for each *naka* orginally constructed.

" 10 to Rs. 15 for each temporary well.

The annual maintenance charges for the work amount to about Rs. 20 to Rs. 25 per square mile and consist of—

(i) the cutting of stool shoots and grass for the entire width of lines and burning the same for—

100 ft. lines, Rs. 12 to 15 per mile,

50 ft. lines, Rs. 8 to 10 per mile,

6 to 10 ft. lines, (cutting only), Rs. 2 to Rs. 3 per mile;

(ii) pressing down tall grass for a width of 50 ft. for a few miles in places at Rs. 3 per mile;

(iii) counter-firing the zamindari forests from the external lines, about Rs. 2 to Rs. 3 per mile;

(iv) pay of watchers at Rs. 5 per mensem; watchers are employed for 4½ months from 1st February to 15th June;

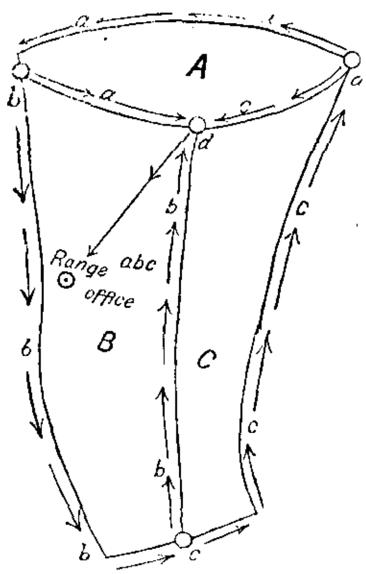
(v) miscellaneous charges such as fire-protection allowance to Foresters at Rs. 2 per month for 4½ months, repairs to wells, and *nakas*, purchase of earthern pots for the use of watchers, etc., etc., Rs. 100.

8. The line cutting work starts every year about the 15th of November and is completed by the 15th of January; then the burning of lines is taken in hand and is finished by the end of January.

Fire watchers are entertained from the 1st of February, two at each *naka*. They first look to the repairs of their *nakas* and wells. After the completion of this work which takes them not more than a week, the work of ticket-patrolling of, and sweeping dead leaves on, the lines, is commenced.

9. The patrol-tickets are pieces of paper about 3" to 4" square with the name of the *naka* from which they start, the date and

the signature of the Range Officer written on them. A known number of these tickets are left in the starting *naka* of each block. The tickets are started in the morning from the starting *nakas* of all the blocks and are carried round the blocks by watchers from *naka* to *naka*. The patrolling is so arranged that the tickets from all the blocks meet at a convenient *naka* in the centre in the afternoon as explained in the sketch below, from whence they are all taken to the Range Officer at Allapilli.



A, B, C, are blocks; a, b, c, are *nakas* from which the patrol-tickets a, b, c, are started in the morning. These tickets are carried round the blocks in the directions shown by the arrows in the diagram until they all meet at *naka* "d," from whence they are sent to the Range Officer.

The Foresters or senior guards in charge of the blocks see that the tickets are carried round regularly each day and inform the Range Officer of what is happening in the forests and in the surrounding zamindari daily by separate reports submitted along with the patrol tickets. The Range Officer who is busy with various departmental works going on in his range at this season, thus gets all the news regarding the fire-protection of the forests in his charge daily in the evening at Allapilli, his head-quarters, where the working population of almost all the neighbouring zamindari villages finds labour on the various forest works going on, such as carting of logs, steam-sawing of logs and scantlings at the mills, cutting and bringing fodder for Government bullocks, building works, etc., etc., up to the number of 200 to 300 men. These men are always available for help in case of a fire occurring in the forests. The Range Officer, as he finds time, pays surprise visits, sometimes at night, to see if the Foresters and

watchers are at their *nakas* and are doing their work properly and also that the right number of tickets are at the starting *nakas*.

The ticket-patrolling of lines is done by one of the two watchers attached to a *naka* by turn, and means about a couple of hours work for him each day. For the rest of the day the watchers are engaged in sweeping dry leaves off the lines, collecting them in beds of *nalas* and other safe places and burning them at night. By about the end of March the sweeping is completed and the lines are all clean-swept of dead leaves and have 6″ growth of green grass on them. About this time zamindari fires are seen in the distance and the Range Officer organizes parties of labourers, and, with the assistance of the Foresters in charge of the blocks, counterfires the zamindari forests from the external lines of his Reserve. In about four or five days the fires started by the Forest Department meet the zamindari fires and the fire burns out at a safe distance from the Reserve, and in this way the Government forests are secured from external danger from fires for the rest of the season. After this the fire watchers keep taking the patrol-tickets round and guard against danger from fires starting within the Reserve by keeping a careful watch on the persons passing through the forests, utilizing their spare time in collecting different kinds of seeds and making bark ropes. The seeds are used either for sowing of blanks in the forests or are sent out to other ranges as necessary, and the ropes are used on departmental works in connection with the carting of logs.

About the 15th of June, when the rains have regularly set in and all danger from fires has entirely disappeared the fire watchers are paid off.

10. The fire-protection is generally very successful and big fires in the Reserve are almost unknown.

CARDAMOM CULTIVATION IN SOUTH MYSORE.

In the Manzarabad and Belur taluks of the Hassan district, Mysore State, and more especially in the Ghat forests of these taluks, the cardamom plant is cultivated extensively. Messrs.

Middleton and Brooke-Mockett, said to be the two largest cardamom planters in South India, have several hundreds of acres under cultivation; while there is scarcely a coffee estate which cannot boast of its "hanal" or "kool," however modest in extent. The words "hanal" and "kool" mean a valley or watercourse. The cardamom plant and the leech revel in moist localities (of which there are enough in the Ghat forests); but the plant, it is said, will not thrive on southern and western aspects. In the Ghat forests the plant comes up spontaneously, wherever a little light has been admitted by the felling of a few large trees; and superstition attaches much virtue to the Balagi (*Pœciloneuron indicum*), the Dupa (*Vateria indica*), the Halmaddi (*Canarium strictum*) and the Naga Sampige (*Mesua ferrea*). The ryot does not seem to be quite sure as to how the plant suddenly makes its appearance; but the general belief is that the seed is disseminated by monkeys, rats and snakes! This belief about the snake seems to be on a par with that other, about the peewit sleeping on his back with his legs raised high to prevent the sky falling on him!

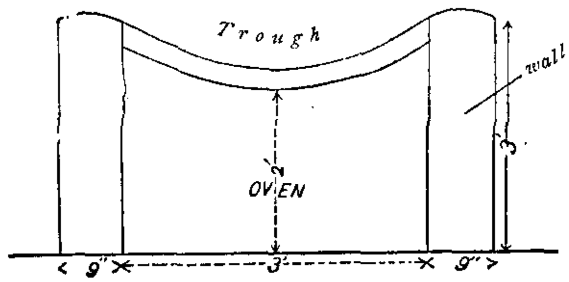
There are two methods of cardamom cultivation—the Brooke-Mockett and Middleton method, and the Coorg system. In the former (I quote from the Inspection Note of the Conservator of Forests in Mysore) the *modus operandi* "is to thin out the forest by removing small poles to such an extent as to let in the required amount of light, and to plant the area thus cleared with nursery—raised seedlings." This done, if facilities exist for the purpose, the area is irrigated, otherwise the area is simply weeded. In the Coorg system "a careful selection is made of suitable areas, such localities being indicated by the presence of plants which have come up spontaneously. In February and March clearings of one square chain, more or less, are made in the selected locality, taking care to fell only small poles from 2 to 3 feet in girth and brush wood. One or two large trees standing by the sides of the cleared plots are then felled right across it, the object of which is two-fold—first, to let in more light, and secondly, to loosen the soil and thus cause the dormant seeds to germinate. The plots are made at intervals of 2 to 10 chains so as not to open out the leaf canopy too

much in one place. The seedlings make their appearance at the first burst of the monsoon, and by the close of the monsoon attain a height of 3 or 4 inches. At the beginning of the following monsoon they are thinned out wherever they are over-crowded, and blank spaces are stocked. All that need be done in subsequent years is to keep the plots clear of weeds. The plants begin to crop in the fourth or fifth year, according to the richness of the soil, and give full crops in the seventh year. They continue to produce good crops till the fourteenth year, when they begin to decline, languish, and die. Then one or two large trees standing by the side are again felled right across the plot. The plants at once begin to revive, and the rhizomes throw out new shoots. This process is repeated every seventh year, and thus renovated the plots last many years. Little or no crop is collected in the years in which the renovation fellings have been made." In the former system of putting out nursery-raised seedlings, the plants are said to "begin to yield at the end of three or four years and are in full bearing at the fifth or sixth year. They continue to bear crops for ten years, when they begin to languish, and have to be replaced by fresh seedlings or bulbs." This is the Brooke-Mockett and Middleton systen ; but it hardly commends itself, even though the plants begin to crop earlier, inasmuch as it is more expensive than the Coorg system and the plants cease to yield sooner. Moreover, as rightly remarked by the Conservator of Mysore, the Coorg system causes the least injury to the forest growth" ; and, therefore, the risks of interference with the rainfall, or with the head-waters of streams, are reduced to a minimum.

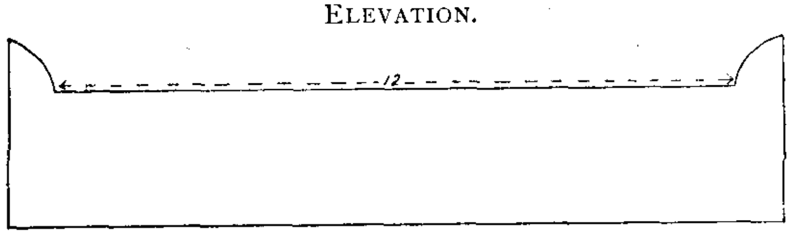
There are two methods of drying the produce—spreading it on mats or in tin trays and exposing it to sunlight, and drying it over a fire. The oven is a long, brick-and-mud structure, the roof of which is either zinc sheeting, or a thin mortar trough, like a long pot-tile. I saw the latter kind of oven at a village named Bimbli ; and I hope the accompanying diagram may explain what it is like. As soon as the zinc sheet or mortar trough is sufficiently hot, a cloth is laid on it and the fruit spread thereon. The object of the cloth is to absorb the moisture ; but it is not

always used. After the fruit is dried, the stalks are cut off, and the produce is then ready for the market. The fruit is not collected till the covering is a white-yellow colour and the seeds nearly black.

CROSS SECTION.



ELEVATION.



Cardamom is a produce which finds a ready sale locally ; and during the cold months of the year, a class of people called "Beries" come across from South Canara and buy up large quantities of it. The Hindus pickle the tender, green fruit ; while in the dry stage it is much used in their confectionery. In Coorg, it would appear that the Forest Department leases out certain plots of forest land for cardamom cultivation for periods of 14 to 21 years, and in this way realizes an annual revenue of Rs. 2,000 to 3,000, and if the Mysore Forest Department will do likewise, instead of playing at cardamom cultivation by departmental agency, as it is now doing, it too might realise similar amounts, instead of insignificant fractions of those figures. Cardamom cultivation should, I think, be left to private enterprise, as coffee is ; and I am sure that the planting community of Mysore is quite as enterprising as that anywhere outside the State.

"Hanals" and "kools" in forests which are not reserved are sold by the Revenue Department by auction, and fetch Rs. 30 and upward per acre. The land, of course, then becomes the private "holding" of the highest bidder, and he has thereafter to pay an annual assessment of Re. 1-1-0 per acre. I do not know what objection there would be to following the same procedure in the Ghat State Forests, which are at present practically unworkable for timber for want of roads. But I leave the matter there.

SAKLASPUR,
MYSORE STATE :
13*th August* 1908.

D. J. EVERS,
Forest Ranger, Manzarabad Range.

MACARANGA DENTICULATA

On page 281 of the May number Mr. B. Sen Gupta gave an account of *Macaranga Denticulata.* In this number he contributes an excellent photograph of a mature forest of this species, about 30 years old.—(Plate 27).

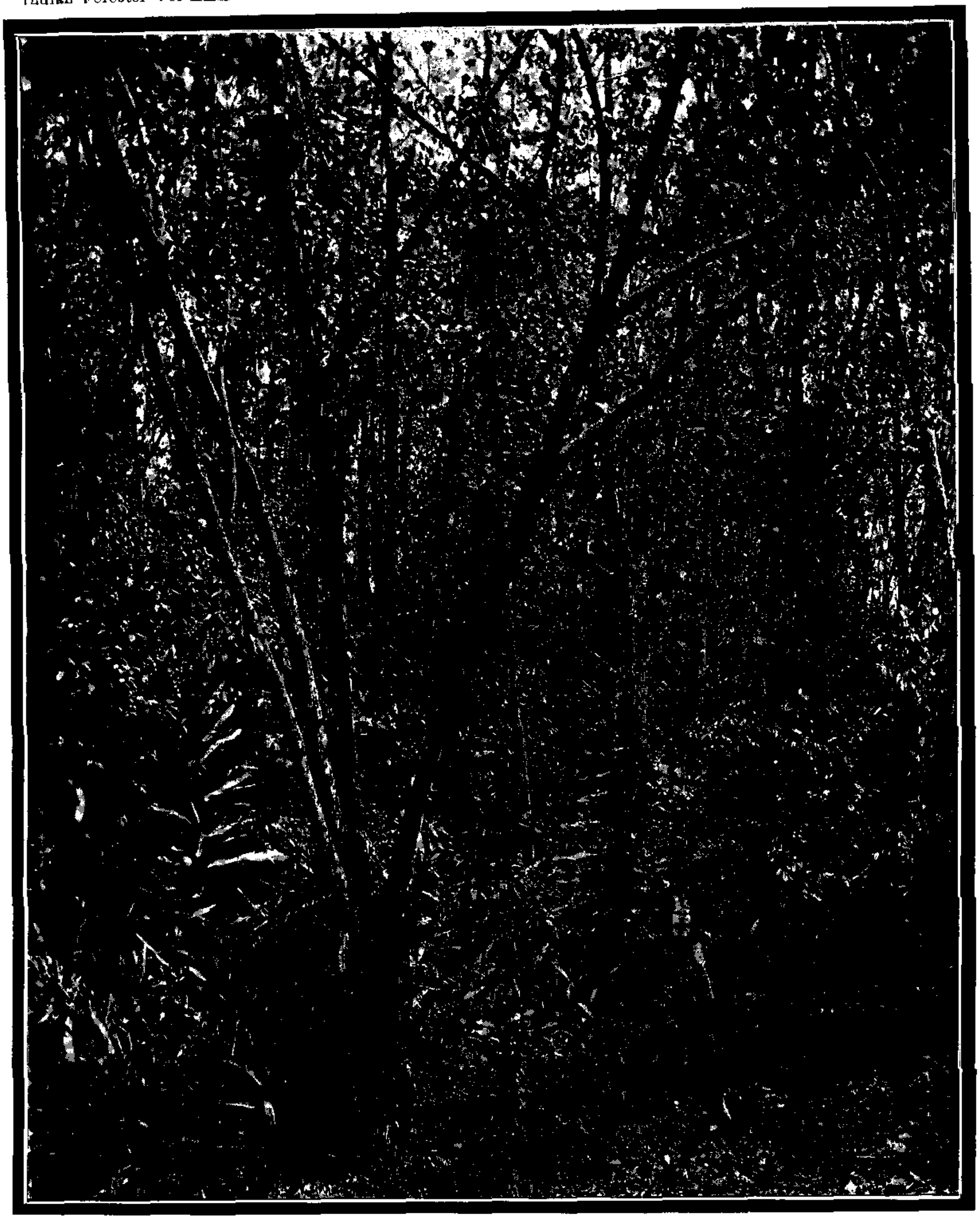


Photo-Mechl Dept. Thomason College Roorkee. Photo by B. Sen Gupta.

Mature Forest of Macarauga denticulata about 30 years old.

EXPERIMENTS WITH EXOTIC TREES IN THE TRANSVAAL.

PROPAGATION OF DEODAR BY CUTTINGS.

[CONTRIBUTED.]

The report of the Conservator of Forests in the Transvaal for 1906-07 is interesting on account of the large number of exotic trees which are under careful trial in his circle. Amongst other remarks the following are of interest:—" As a result of the difficulty in obtaining good fresh seed in any quantity of *Cedrus deodara* the Forester has been making some experiments in striking that tree from cutting and has got very satisfactory results. 90 per cent of the cuttings set have callused and formed roots and are now making healthy plants. Junipers of various sorts are also being propagated in the same way with equal success. These results are of considerable importance as they indicate a way of rapidly propagating desirable species which have not hitherto been cultivated to the extent they merit on account of the difficulty of raising transplants."

Instances of the coppicing of deodar are frequent though little advantage has been taken of this peculiarity, but that the tree can be struck by cuttings has either not been known or failed to have been appreciated in India.

Many kinds of Eucalypts have been experimented with; *E. coriacea* and *E. viminalis* bore the severe winter frosts but suffered from late frosts in May. These species might thrive well in the Himalayas where the latter danger is not to be anticipated. *E. rostrata* also bore the cold well, but *E. melliodora, polyanthemos, bicolor, sideroxylon, creba* and *globulus*, especially the last named, would appear to be unable to withstand the severity of winter at high elevations. *E. citridora* appears to be distasteful to white-ants. Wattle and blackwood have done exceedingly well.

CURRENT LITERATURE.

Memoirs of the Department of Agriculture in India.—*Entomological Series, Vol. II, Nos.* 3 *to* 5.—All these numbers are by H. Maxwell-Lefroy, M.A., F.E.S., F.Z.S., Imperial Entomologist.

In No. 3, the Red Cotton Bug (*Dysdercus cingulatus*, Fabr.) is described. This insect is stated to be the representative in India of that class of pests known as "cotton stainers" which are specific pests of cotton practically throughout the tropics. After quoting the description of the insect by Distant, the author specifies its life history, the damage caused by it, its enemies and the most suitable remedies.

The castor semi-looper (*Ophiusa melicerte*, Dr.) is dealt with in No. 4. The genus *Ophiusa* of the family *Noctuidæ* is widely distributed, forty species being recorded from India, Burma and Ceylon of which no less than seventeen have a wide distribution in the plains of India. However of all these, *O. melicerte* is alone known as an injurious insect. This species occurs throughout the Himalayas, Assam and Burma, throughout the hilly forest areas of India proper and over the whole cultivated areas of India with the exception possibly of former desert areas now under irrigation. The memoir gives details of the life history, damage caused, enemies, and possible checks, all of which information will be of great service to those interested in the cultivation of castor (*Ricinus communis*).

Mr. Maxwell-Lefroy gives an account of the Tobacco Caterpillar (*Prodenia littoralis*) in No. 5. This also belongs to the family *Noctuidæ* and is common throughout India. After dealing with the life history the author gives the names of the various food plants which it has been known to attack. The list comprises a great variety of plants such as—cabbage, lucerne, castor, rice, maize, jute, tobacco, indigo, potato, etc., but it is chiefly known as a serious and general pest to tobacco in India. The memoir closes with a description of the enemies of this insect and suggestions for combating it.

All these three memoirs contain excellent coloured plates illustrating the various stages of the pests they deal with.

CONSERVATION—WOODS AND WATERS; SOILS AND ORES FOR AUGUST 1908.—This is the new title of *Forestry and Irrigation*, the chief reason for the change being that the title recently in use was not comprehensive enough. This number opens with "A Plea for Nationalisation of our Natural Resources," by H. Riesenburg.

In this the urgency and advantage of managing the natural resources by national agency is powerfully put forward. " Railroad Forestry Work " describes how the Pennsylvania Railway Company is planning for a permanent timber supply of its own by conservative lumbering and planting up of the land at its disposal. " National Forests Redistricted " explains the recent alterations in the boundaries of practically all the national forests in the States of California and Washington. The Forest Service desires to reduce the area of the average administrative charge to one million acres. This was not possible in all cases as in the plan of redistricting, there will be 144 supervisors in the United States for 167 million acres of national forests. From the article entitled " New Commission at Work," we learn that the National Conservation Commission met in Chicago on June 19th and perfected its organisation. The first work of the Commission—that of taking an inventory of the nation's natural resources—has already been commenced and will be presented at the meeting to be held in Washington next December. Mr. Gifford Pinchot is chairman of the executive committee of the Commission.

THE BOTANICAL GAZETTE FOR AUGUST 1908.—*This issue* contains several most interesting papers. " Floral Succession in the *Prairie-grass Formation of South-eastern South Dakota* " by LeRoy H. Harvey is graphically written and affords quite fascinating reading. G. F. Freeman describes " A Method for the Quantitative Determination of Transpiration in Plants," while A. Dachnowski contributes " The Toxic Property of Bog Water and Bog Soil."

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE DEGENERATION OF TIGERS IN THE CENTRAL PROVINCES.

For the purposes of this article I have found it necessary to draw a distinction between the different tiger-producing tracts of the Provinces. Roughly speaking, the Central Provinces may be

divided into central districts and outlying districts. The central districts are those which are almost entirely surrounded by forests, typical of which are Mandla or Betul. The outlying districts are those which contain large tracts of cultivated ground bordering on their forest areas, typical of which are the Jubbulpore or Hoshangabad districts.

No marked degeneration has been noticed in the central districts as yet, although a certain amount has probably taken place, as it is reasonable to suppose that the causes of degeneration in the outlying districts will in time equally effect the central district.

During the current year the following adult tigers were shot in the Hoshangabad district having the following dimensions :—

Serial No.	Sex.	Length of body and tail.	Length of tail.	Weight.
1	Female ...	8′ 2″	2′ 4″	270 lbs.
2	Do. ...	8′ 1½″	...	258 „
3	Do. ...	7′ 9″	...	260 „
4	Do. ...	8′ 5″	...	290 „
5	Do. ...	8′ 3″	...	293 „
6	Do. ...	8′ 0″	...	260 „
7	Male ...	8′ 11″	2′ 9″	383 „

The average of the six adult females works out to 8′ 1½″ in length and 265 lbs. in weight. The only adult male shot was 8′ 11″ and weighed 383 lbs. The measuring was done in a straight line between pegs driven in at the tip of the nose and the tail, the weighing was carried out on a spring balance.

In comparing the above figures with those obtained in past years, I have attempted to select figures got from tigers shot in outlying districts, as, for purposes of comparison, it is somewhat misleading to compare tigers from, for instance, a district like Mandla with those of Hoshangabad.

About seven years ago the average length and weight of an adult female was 8′ 5″ and the weight was 298 lbs. Since then the degeneration is steady and gradual until the present year shows a loss of 3½″ in length and 33 lbs. in weight. As regards males the degeneration is quite as marked. We have got down from 9′ 2″ and 419 lbs. to 8′ 11″ and 383 lbs.

Several sportsmen who have had a long experience of the Provinces have noticed the same falling off in size of the tigers from the outlying districts. The cause or causes are difficult to find, no explanation which I am able to put forward is altogether satisfactory. From old records and books of sport it is evident that the process of degeneration has been going on previous to the enormous increase of shooting in the last decade. We find in old records that tigers well over 10 feet were not so rare, and, although doubts on the accuracy of many of these records may be entertained, it is impossible to reject them all. It may also be urged that measurements in former days were taken along the curves, but this, in a 10-feet tiger, would only reduce its length by 5″. The following, however, are a few of the modern conditions which strike me as possibly accelerating the degeneration. Shooting has increased to a remarkable degree especially in the outlying and accessible districts. Generally speaking, in these districts the tigers shot are not born and bred in the forests of the district, they are mostly wanderers which have come in from the central districts during the rains. It is reasonable to suppose that the younger and less powerful animals would be pushed out from the more favourable central districts, but this in itself does not fully explain the matter.

Tigers probably do not reach maturity until they are 4 years old but for many years after, probably 10 or 15, they increase enormously in bulk and weight. These heavy old tigers are now getting scarce, and at a guess it is possible the average age of

the tigers of the outlying districts has been reduced by one-fourth in the last 10 years. If this is one of the chief causes of the degeneration noticed, we may expect the process to abate shortly. The question is one of general interest to sportsmen, and I trust some reader who has had more experience of the matter than I have will give us the benefit of his views on the matter.

A. A. DUNBAR BRANDER.

RINGED BIRDS.

The winter quarters and routes of our migrant birds are until now yet unknown, and there is only one method which leads to positive knowledge on this account: the marking of birds by aluminium rings, a method which has been tried with success in, Germany and in Denmark, as a house-stork marked in Pomerania was caught in Africa, 15° S. of the Equator. The Hungarian Central Bureau for Ornithology has now also begun the marking of young storks, herons, gulls and swallows. The aluminium ring is fastened around the leg of the bird and it bears in each case the inscription "*Budapest*," followed by a number which corresponds to the entry in the Register-book of the Hungarian Central Bureau for Ornithology. Any one catching such a marked bird or hearing of the capture of such, is kindly requested to send the ring on to the Hungarian Central Bureau for Ornithology, Jozsef-korut, 65, Budapest VIII, Hungary, accompanied by a notice stating the locality, time and particulars of capture.

OTTO HERMAN,
Director of the Hungarian Central Bureau for Ornithology.

BUDAPEST:
July 1908.

EXTRACTS FROM OFFICIAL PAPERS.

PROCEDURE TO BE FOLLOWED IN THE DISPOSAL OF REQUISITIONS FOR FOREST PRODUCTS.

Inspector-General of Forests' Circular No. $\frac{16}{289\text{-}8}$, *dated* 18*th August* 1908, *to all Chief Conservators and Conservators of Forests.*

In order not only to utilize the staff and collections at the Forest Research Institute, Dehra Dun, so as to efficiently meet enquiries and requisitions regarding forest products, but also to prevent the duplication of work both in collection and investigation, it appears to be desirable to arrange that a more careful scrutiny may be possible into the demands made on Forest officers for specimens of forest products so that the time and labour spent on this work may in future be reduced.

2. Indents received by Forest officers may be classified broadly under two heads—

I. Those emanating from foreign countries, often for considerable quantities of seed, for samples of commercial, products, for museum specimens, etc.

II. Those received from England or India from official or private individuals for samples of forest products, botanical or wood specimens, etc.

Indents under the first heading are in many cases addressed to the Government of India or to Local Governments and are transmitted to suitable Forest Circles whence the material is supplied direct to the country concerned. Such indents do not occupy much time or cause much trouble, they comprise as a rule well known articles whose collection and despatch is a purely business matter. It is otherwise with indents coming under the second head. These are sometimes addressed direct to the Inspector-General of Forests and at others to local Forest officers, often to two or more officers simultaneously and, perhaps unavoidably, with insufficient regard to the locality of origin of the product or specimen asked for, or to

the trouble and expense entailed in searching for an object which may be rare in the locality selected.

3. To remedy these disabilities it is proposed to constitute at Dehra Dun a Bureau of information and of distribution for indents on the Forest Department, open to the use of all those who may wish to save time and trouble in this regard. The procedure which it is proposed to adopt is as follows :—

(i) Enquiries on all questions relating to forest products may be addressed to the President, Forest Research Institute, Dehra Dun, who will either personally or through one of the officers attached to the Institute reply thereto at once ; or he will, after investigation made by the latter, publish the results thereof if considered of sufficient importance.

(ii) The President, Research Institute, will receive indents for forest products or specimens and distribute them *in such a manner that there shall be no duplication* of material or of research. Forest officers are invited to transmit to him any indents they may receive of a general nature so that if necessary the various items may be assigned as far as possible to those who are in a position most readily to collect them. As a rule subsequent correspondence will be carried on direct by the supplying officer, but if so desired the President, Research Institute, will, through the agency of the Research officers, undertake such correspondence, if thereby any relief is afforded to local Forest officers. In any case the articles collected should be transmitted direct to the parties indenting, and the President, Research Institute, would be glad to receive notice of the completion of an indent so that the case may be struck off his books. In this regard it has been already arranged that indents from the Reporter on Economic Products should in future be sent not to Forest officers direct but to the President, Research Institute, so that these officers may be in a position

to keep each other informed when a new subject of investigation is taken up and be in a position to decide by whom the investigation is to be conducted.

4. Inspector-General of Forests' Circular No. $\frac{3}{551\text{-}4}$, dated 4th March 1908, is hereby cancelled.

FOREST DEVELOPMENT.

As a proof of the attention which the cultivation of timber is now receiving in all civilised countries, reference may be made to a circular issued by the United States Forest Service setting forth some striking facts of what forestry has done, and pointing out how necessary it is that forestry should be looked upon as a matter of necessity. Mr. Cleveland goes so far as to say that the nations which follow forestry most widely and systematically are the most enlightened and progressive, and that a country without forestry may be set down as a backward one. The exception is England, which, though provided with mountain and heath land capable of producing a large part of wood for home consumption, has, with strange indifference, depended mainly upon foreign sources for her supplies. Thanks chiefly to Norway, Sweden, and Canada, we have been able to count with certainty upon a steady supply. This, however, threatens to cease, or, at any rate, to be considerably lessened, and before long, unless steps are taken for the production of home-grown timber, we shall experience considerable trouble. We agree with Mr. Cleveland that the science of forestry is one of the most practical and directly useful of all the sciences, and that systematic forestry applied by the nation for the benefit of the people must sooner or later be forced upon every country.

In Germany there are 35,000,000 acres of forest, over half of which belongs to the State or corporations and associations. Forestry there is working out remarkable results, and the Germans appear to have solved the problem of securing an increasing forest

output, with increasing profits at the same time. In every State in Germany forestry is a success. Prussia, which has nearly 7,000,000 acres, has multiplied the rate of production three-fold in seventy-five years, whilst the financial returns from forestry are said to be nearly ten times what they were sixty years ago. Private forests in Germany also are managed with great success.

France has 23,500,000 acres of forest, one-fourth of which is owned by the State and the departments and communes. The State forests yield a clear profit of nearly a million a year. Up to the beginning of last century France paid no attention to its protective forests, and as a consequence large areas of land were practically waste. Since then much has been done both by the State and private landowners to restore this waste land to forest. The State now acquires annually from 25,000 to 30,000 acres a year to be devoted to forestry. The great stretches of sand, instead of being a constant menace to farmers, are now covered with pine forests which produce valuable wood and resin. The communes, encouraged by the State and imitated by private owners, have in about fifty years changed some 2,000,000 acres of worthless shifting sands and marshes into a profitable forest valued at £25,000,000. In Champagne 200,000 acres of arid limestone waste land have been reclaimed by forest planting at a cost of £2 per acre, and a consequent rise in value from £1 to £10 per acre. "In France forestry has decreased the danger from floods which threatened to destroy vast areas of fertile farms, and has added many millions to the national wealth in new forests. It has removed the danger from sand dunes, and in their place has created a property also worth millions."

Switzerland has 2,000,000 acres of forest, 67 per cent. of this being communal. Forestry has long been practised in that country, the city forest of Zurich having been managed under a working plan since 1680, and to-day it is one of the most perfectly managed and profitable forests in the world. All forests, whether public or private, are controlled by the Government, and grazing has been regulated for centuries, being entirely prohibited in what are termed protective forests. Every foot of land is cultivated in

Switzerland, that which is not suitable for agriculture being utilised for forestry.

Austria has 24,000,000 acres of forest, about half of which is under private ownership, some of the estates being over 300,000 acres in area. In that country private forestry is encouraged by the forests being exempt from taxation. The net revenue from the Austrian State forests is about £1,000,000 a year. In Hungary, where there are 23,000,000 acres of forest, planting is encouraged by State nurseries, from which 10,000,000 seedlings are distributed free every year: bounties also are paid for forest plantations established on private waste lands. There are 20,000,000 acres of forest in Norway, but in that country forestry is said to be on a low level. Sweden has 50,000,000 acres, from which 4,500,000 tons of timber are annually exported, half of it to England. In Denmark there are 600,000 acres under forest, and another 75,000 acres of wastes are in process of afforestation.

The Russian forests are of vast extent, covering nearly 600,000,000 acres, 65 per cent. of which belongs to the State. It exports £6,000,000 worth of wood annually, chiefly to England, Germany, Holland, and France. Italy has 10,000,000 acres of forest, and Spain about the same area.

Statistics show that Great Britain and Ireland import nearly 10,000,000 tons of timber, or nearly as much as all the rest of the world combined. The bulk of this comes from Sweden, Russia, and Canada; but Mr. Cleveland is of opinion that unless the countries of the western hemisphere apply forestry promptly and thoroughly, they will one day surely be held responsible for a world-wide timber famine. Not only must forest waste be put an end to, but the application of forestry to large areas of land which is at present practically waste must be undertaken immediately if a shortage of timber in the near future is to be prevented. We are told that countries which have hitherto exported their wood are recognising the necessity of curtailment, and that England, which has been depending almost entirely upon a foreign supply, will have to look elsewhere to secure her needs in the near future. —(*The Field.*)

FORESTRY IN SCOTLAND.

The Royal Scottish Arboricultural Society has laboured long, and without much encouragement, to promote interest in forestry in Scotland. Its leading supporters have contended that opportunities have been neglected for the profitable afforestation of extensive areas in the Highlands, and for years they have striven to impress upon land-owners and the Government the possibilities that were being disregarded. The Society was instituted more than half a century ago with the object of extending and improving wood-growing north of the Tweed; and after years of patient work that appeared to bear little fruit the Society is now beginning to discern evidences of benefit resulting from its labours. In a letter which he issues along with the annual "Transactions" of the Society for the current year (Douglas & Foulis, Castle St., Edinburgh, 3s.), the President, Sir Kenneth J. Mackenzie, makes an urgent appeal for new members, in order that the Society may be in a stronger position to further the interests of forestry throughout the country. He points out that the work of the society in the past has been carried on along educational lines, by publishing "Transactions," by making excursions to woods at home and abroad, by organising exhibitions of forestry throughout the country, and by affording to the members of the Society, through its honorary scientists, gratuitous advice on subjects relating to forestry. It has also periodically held conferences with the President of the Board of Agriculture, which have resulted in the appointment of various Government committees whose reports have been of great value. He also refers to the work of the Society in providing means for obtaining systematic instruction, and notes with satisfaction the institution of a school of forestry at Edinburgh and lectureships in connection with the three Scottish colleges of agriculture; while arrangements are being made to provide forest gardens in connection with the East of Scotland College. But, while a full course of theoretical instruction may be obtained in Edinburgh, it is unfortunate that, owing to the absence of demonstration forests, students are still compelled to spend a considerable time abroad before they can complete their practical course of

instruction, and so secure their degree. In the purchase of Inverliever estate the Government has at length recognised the principle of State afforestation, but, as that estate is rather inaccessible and is practically devoid of timber, it cannot in the meantime satisfy our immediate educational requirements. The Society is, therefore, still urgently pressing the Government to meet this need by providing a suitable demonstration forest and further educational facilities. After alluding to the possible exhaustion of timber supplies from abroad and to the falling rents of sheep farms, the President suggests increased afforestation as a means of keeping the population on the land, and argues that in this work the Government might properly take a part. The Society has accordingly recommended that the Government should create a Board of Forestry for Scotland, or a commission under the Board of Agriculture to foster and promote State and private afforestation with power to survey and indicate all land suitable for the purpose, and with sufficient funds to carry on its work efficiently. With the object of strengthening the hands of the society, he strongly appeals to landowners and others interested in land who are not members of the society to give their support. The new volume of "Transactions" contains a number of instructive articles on important subjects.—(*Times.*)

THE COMING TIMBER FAMINE.

A general famine of timber all the world over within thirty years of the present date is unhesitatingly prophesied by Mr. Angus Hamilton of Berkeley, California, in a letter to the *Times*. Mr. Hamilton, it will be seen, believes that England holds an answer to the situation in the forests of Uganda; but his predictions may rouse the Indian Forest Department also to be on the *qui vive* while there is time. He writes :—

To those of us who have spent the greater part of a lifetime in the international timber trade and have travelled extensively the timber-producing regions of the world, it is a self-evident fact that a time of scarcity is approaching much more rapidly than most

people suppose—I would place the time of scarcity at 25 to 30 years. At the present rate of consumption the United States supply will certainly be exhausted in about that time and Canada, with the United States drawing on it from now on, cannot hold out much longer. All the most accessible timber on the shores of the Baltic has been used up, and the interior supply will be gone in less than 30 years. With conditions like these to be met in so short a time what are you to do in the Old Country to meet it ?

In the short space of 30 years it would be impossible to meet this famine by planting, and while your home timber is growing it is necessary you should look up some other source of supply. The two most likely regions are the Amazon or the Uganda Protectorate. As the timber regions of Uganda above 4,000 ft. are suitable for white labour, it seems to the writer that this is a much more desirable region to develop than the Amazon, and being within the Empire would be free from the tri-weekly revolutions so common in the South American Republics, consequently giving greater security to the capital necessary to develop the forests.

To get this timber from Uganda into the British market at a reasonable price, it means that experience and energy must be put into it. Boys from school cannot do this. Woodcraft can only be learned in the woods. The very best skilled lumbermen of the broad-gauge type must go into this business along with the investors' money if a profit is to be made. I was very much amused on reading an article by Mr. Winston Churchill in the *Strand Magazine* lately describing the primitive methods employed to supply the Uganda Railway with cordwood for fuel. I quite agree with him that modern methods must be introduced if this Uganda timber is to be used as a commercial asset of the Protectorate ; logging railways must be built, steam logging machines introduced, and modern up-to-date band-saw mills constructed. Steam, electricity, or compressed air are much more serviceable than a lazy nigger. On one point I must differ from Churchill, and that is about the use of the " steam tree feller." In such a forest as he describes it would cost more to clear a way for the feller than it would do to cut the timber by manual labour. To give a start to the timber

business in Uganda it would be necessary to man the woods and mills at first with skilled white labour, and by this means gradually educate the young natives. The young natives can be trained up to be good useful woodsmen, but the old ones never. At least this has been the writer's experience in the Black belt of the Americas. The old ones sooner or later return to their banana or cotton patches, but the young ones, reared around the mills and woods, usually stay with the plant. There is a large area of timbered country that is at least comparatively healthy and suitable for white settlement, and should be the first part to be developed. This region is known as the Mau Escarpment, and lies between Lake Naivasha and the Kasova Hills on the eastern shore of the Victoria Nyanza. This forest can easily be reached by logging railway from the existing Government railway, and with proper appliances and skill the timber could be placed on boardship at Mombasa at about 12*d.* per cubic foot, that is provided the rates on the Uganda railway are reasonable. Steamers of, say, 6,000 to 8,000 tons can carry it to London or other British ports at 4½*d.* per cubic foot. In all about is 1*s.* 4½*d.* c. i. f. the Thames, the price of pitch pine, but in less than ten years the price of pitch pine will not be less than 1*s.* 10*d.* per cubic foot c. i. f. British ports. Timber companies going into Uganda should be very careful to see that their medical staff should have a thorough knowledge of tropical medicine as the health of the employés is of prime importance in an undertaking of this kind. All camps should be carefully screened to protect the workers from the insect pests which communicate disease, all water should be boiled or artesian wells bored, a small ice plant should be installed at each saw mill to supply ice to the village and the logging camps along the companies' railway. With proper precautions there is no reason why the timber in river bottoms cannot also be logged out.

The writer has lived in some of the worst malarial regions on the American continent for years without having a single attack of malarial fever, and I am convinced the same thing can be done in Uganda. A proper diet of well-cooked food, plenty of ice, protection from insects, and as little direct sunlight as possible, will enable

the white man to live in almost any climate. Do not be afraid to tackle the problem of getting out the Uganda timber, for it can be done.

I estimate the timber area of Uganda at 40,000 square miles, that is to say, 25,600,000 acres, which at 1,000 cubic feet per acre would yield 25,600,000,000 cubic feet in all. Why should this enormous forest be allowed to rot on the stump when you need the timber so much at home? It is a self-evident fact in a forest that is perpetuating itself that it decays as fast as it grows, and we know that this decay and growth is about 40 cubic feet per acre per annum, hence there is 1,024,000,000 cubic feet rotting in the forest of Uganda every year. For the benefit of the general reader I may state that this annual decay of timber would, if converted into sleepers, be sufficient for 170,000 miles of single track railway, and all this without injury to the forest.

To encourage capital to this business the timber would require to be sold in large areas, say 50,000 to 100,000 acres. It would take this amount of timber to justify timber companies going to the expense of building railways, steam-logging appliances, and large modern band-saw mills. A plant of say, 10,000 cubic feet daily capacity would be required to be assured of a ten or fifteen years supply to justify the expense; and, as far as I can learn, the forest laws of Uganda would have to be re-arranged to meet those requirements and before people could be induced to risk their money in the business. The Government should send some practical timbermen and foresters out to report on this field and to draw up commonsense laws for the exploitation and conservation of the forests. Here within the Empire you have timber enough to supply all your needs until you can grow your own at home.

My advice to you at home is to plant every available inch of ground. Don't say you haven't any. I know of several millions of acres in England, Wales, Ireland and Scotland that can produce a profitable crop of timber, and which in the interest of coming generations should be planted. Assuredly this timber famine will be upon you in less than 30 years.—(*The Pioneer.*)

AFFORESTATION, SOUTH AFRICA.

In India at the present time the subject of afforestation is, as some of our readers are no doubt aware, engaging the earnest consideration of the Government of India. It seems to be the experience in every part of the world that the destruction of forests and vegetation creates dessication, causes floods and results in a diminution of the permanent flow of springs and streams. From the report of the Inter-Colonial Irrigation Commission, South Africa, we find that this matter is also being closely considered by the South African authorities. The attention of the Commissioners was drawn to the evil effects of grass burning, which is so largely practised in the Transvaal and the Orange River Colony, and to the necessity for afforestation—two factors which are intimately connected with the conservation of water and which exert a powerful influence on the natural water-supply. We gather from the evidence laid before the Commissioners that it is a disputed point whether the custom of grass burning was as common among the aboriginal natives as it is to-day among the white races; but evidence was adduced to show that it has been universally practised since the days of the Voortrekkers. Those who advocate the practice claim that veld burning removes the rank coarse growth and provides a supply of young tender grass for their stock. Another argument advanced is that the fires destroy the ticks which infest the Low Veld districts, and that without their periodical clearance the insects would increase so enormously that they would become a serious obstacle to stock farming.

It is quite true that veld burning does provide a supply of young grass, but many farmers agree that the disadvantages far outweigh any possible advantages and it has been described by one of the witnesses as the most pernicious practice ever invented by man. But it is in connection with the loss of the natural water-supply that veld fires work the greatest evil. The rainfall does not penetrate so freely into the soil where it is denuded of its covering. The surface of a "burn" becomes so baked and hard that the bulk of the rainfall runs off it as if from a roof.

It has been found that veld burning is a potent factor in drying up springs and causing *Dongas*, both of which contribute towards the dessication of the country: the latter act as huge drains for carrying off the sub-soil waters of the surrounding valleys. The leading men in the Transvaal and Orange River Colony have long recognised the pernicious evil of veld burning, and many years ago the late Republics introduced legislation dealing with the subject. A number of farmers have abandoned the practice but they are still at the mercy of any neighbour who may start a fire. Quite recently a fire which originated near Lake Chrissie swept the country down to the Swaziland border!

It has been suggested that the great practical remedy, the results of which would be even more beneficial than water storage, is afforestation. The Members of the Inter-Colonial Commission, though not entirely prepared to endorse this view, record their opinion that they recognise the value of forests in connection with the natural water-supply and the necessity for a large extension of the afforested areas. As is already fairly well known, forests besides lowering the temperature and reducing evaporation cover the ground with a thick layer of moisture-absorbing humus: the leaf mould that is formed on the surface of the ground has great powers of absorption: the trees, roots and layers of humus—by friction, absorption, reducing gradients, etc.—form such obstacles to the movement of water that under ordinary conditions there is practically no surface travel in a forest and consequently very little erosive action. Part of the rainfall percolates into the sub-soil to strengthen the natural supply, and the surplus slowly finds its way into the neighbouring streams and thus contributes to the permanence and regularity of flow. In countries where the population is mainly agricultural any material diminution in the permanent flow of springs and rivers would be calamitous. The question of afforestation is therefore one of the first importance in such countries, and it is gratifyng to know that the responsible authorities are quite alive to its importance.—(*Indian Engineering.*)

ORIGINAL ARTICLES.

INDIAN FOREST RESEARCH.

Every forester welcomes most cordially the recently established Indian Forest Research Branch, and recognises that systematic research and permanent records of its results are of immense value to Indian forestry. It is to be hoped that, in the pursuit of research, the very important duty of instructing the forest rangers of India, by thoroughly qualified men, trained in Europe, will not be lost sight of. Englishmen alone cannot establish forestry on a firm basis in India, their efforts must be seconded by an equally devoted, active, intelligent and well-trained body of native rangers.

Alone of the able men, recently appointed, or to be appointed to the research branch, and including Messrs. Troup, Coventry, Percival, Fischer, who are, or have been, studying their respective subjects in Europe, Mr. Stebbing does not acknowledge the literary work published in India, or elsewhere, of his predecessors. Apart from "Indian Museum Notes," and the publications of the Agricultural Entomologist of the Government of India, there are no references, in the preface of "The Manual of Indian Forest Zoology," to any Indian forest entomologists, who have paved the way for that work, or have helped him in its preparation by sending him specimens of the ravages of Indian insects, nor to that distinguished entomologist and able and kindly instructor, Mr. W. F. H. Blandford, then Secretary of the Royal Entomological Society, who taught Mr. Stebbing at Coopers Hill.

In the September number of the *Indian Forester*, in the report of an address given by Mr. Stebbing, at a conference of Punjab Forest Officers, we read :—

"A man to be a good Forest Officer at all must be an observer. And the Department has had some excellent foresters. It is that they did not, for the most part, record what they have observed." Again :—"Sal, Teak and Deodar are not the only timbers in India, and yet, where is the contractor, who will take anything else, if he can get these? And yet we probably possess timbers that

would serve his purpose equally well, and which we could let him have at a cheaper rate. But we do not ourselves know their qualities and cannot therefore push them." How about Padauk from the Andamans, Sandalwood and Red Sanders, Boxwood, Oak, Kail, Chir and Magnolia from the Himalayas; Jarul, Nageswar, Gondsorai and Shama from Assam; Pyngado from Burma, and all the representative fifty Indian timbers, of which Nördlinger years ago, prepared boxes of thin sections for the Dehra Dun students, and which have been also for years past studied in the laboratories at Coopers Hill and Oxford, large pieces of these woods having been sent home from India, and made into thin sections by the forest students?

The original work on "Indian Timbers," prepared from specimens collected by Brandis, and cut into sections by Gamble and Smythies, was written from Brandis' dictation by Gamble and published by him; the second edition of this work was enlarged greatly by Gamble and represents years of arduous work by the latter. This second edition gives as detailed and complete an account of Indian timbers, as that for any country, or by any author, yet this inestimable work is ignored by Mr. Stebbing, who says that we know nothing of the qualities of Indian timbers!

The only reference made, in this address, to past literary work in India, is as follows :—

"To put down observations in obscure divisional journals, or in annual reports is merely to render them unavailable for general reference."

Surely, if Mr. Stebbing had said that many Forest Officers in India are too much occupied with administrative work to find time to read the records of the past, and that the present research branch will have the necessary time, both to carry out research and to record the results of past and present work, in a form more available for study, no one could cavil.

In Ribbentrop's "Forestry in India" is a list of the literary work done by Indian foresters up to 1900, and I need only refer to that list to show the great value of that work. Both Mr. Stebbing and Mr. Eardley-Wilmot, in their ignorance, or contempt,

for past literary work by their predecessors, have systematically belittled that work. The latter, for instance, in the pages of this Journal, denied to Dr. Schlich the merit of organising the home training of forest students and of initiating the *Indian Forester*, both of which he wrongly attributed to Brandis. The latter has done splendid literary work in his Indian Forest Flora, and in his excellent "Suggestions," wherein, after inspecting all the forests in India, he has recorded not only his own, but also the observations of the local Forest Officers, whom he consulted. The Indian Forestry Department has a glorious history in the past, why therefore in the pages of a journal, that is read wherever English is spoken, belittle the work already done by it?

The writer of this paper has been accused recently, in the *Pioneer*, by Mr. Stebbing, of making false statements and of ignorance of the present developments of Indian forestry. The absurdity, to say nothing of the bad taste, of the former accusation was at once exposed in The *Pioneer*, the editor of which also promptly sent me Stebbing's "Manual of Indian Forest Zoology" for review in its columns, and Mr. Stebbing was called upon to substantiate his assertions, a duty that, so far as I know, he has neglected. As regards my alleged ignorance of Indian forestry, it is sufficient to say that I read all Indian Forestry literature, as soon as it reaches our Forestry Library, of which I am custodian, and also that nearly every Forest Officer, home on leave, calls on the Professors of Forestry at Oxford, so that both by reading and by prolonged discussions with these gentlemen, we are always posted up in the latest developments of Indian forestry, and constantly refer to them in all our lectures. Professor Schlich also gives special courses on Indian forestry and forest accounts. Mr. Duthie, or Mr. Gamble, give lectures on Indian Forest Botany, Professor Somerville lectures on the structure of Indian timbers, and refers to Indian fungi, as far as data from India are available, in his lectures on the diseases of plants; due reference to Indian insects is made by Mr. Grosvenor, the lecturer on Forest Zoology, while Dr. Trevelyan, a retired High Court Calcutta Judge, lectures on forest law.

In conclusion, I hope that it may be possible in India to combine research with instruction. In all European forest schools the Professors of Forestry combine these two branches, their teaching work being light enough to allow plenty of time for research, and this fact should always be considered in instituting forest schools, which cannot be really effective if the hours devoted to instruction by the professors are too long. The instructors are chosen from selected members of the forest staff, who, after having spent sufficient time in practical forest work to become acquainted with it, are deputed for instruction and research, and do not revert to their former administrative posts. It is only by thus *separating the brain of the Forest Department from its body that* good permanent work can be done, and it is lamentable that Mr. C. G. Rogers, and Mr. Haines, both of them distinguished instructors and scientists, should have now become mere administrators, when the Government of India would have gained much more by retaining them permanently at Dehra Dun. It is evident that good officers should not suffer pecuniarily by such employment in the purely scientific branch of the Forest Department, but that could be arranged easily, by allowing them to continue to draw their ordinary increments, when they become qualified for posts as Conservator of Forests. It is to be hoped that Mr. Stebbing, who is doing such excellent work in Forest Zoology, may be spared from the fate of reversion to a purely administrative post. In 1888 or thereabouts, I suggested to Government that the post of Director of the Forest School should be separated from that of *Conservator of the School Circle, and that he should be employed* totally in instruction, research and direction of the school, and Mr. Wilmot deserves our gratitude for having accomplished this reform and separated the post of Principal of the College of Forestry, and President of the Research Branch, from all merely practical forest work, as well as for establishing the Forest Research Branch.

OXFORD: W. R. FISHER.

22nd September 1908.

SANDALWOOD AT LOW ELEVATIONS.

In an article headed "Sandalwood at Kurnool" published in the *Indian Forester* for August 1906, conclusive proof of the normal development of scented heartwood in sandal trees grown at elevations of 950 feet and 900 feet at Kurnool and Salem respectively was adduced. In another article entitled "Sandalwood at Sea-level," published in the same Journal in March 1908, some proof of the formation of scented wood in trees grown at Pondicherry at sea-level was recorded, and subsequently Mr. F. B. Dickinson's observation of scented wood in trees grown at Cannanore on the west coast, recorded in the *Indian Forester* for February 1883, was reiterated in that Journal for July 1908. Since then, I have collected incontrovertible and conclusive evidence of the development of good scented wood in trees grown at elevations of and below 400 feet in Travancore, and the following are the facts that constitute that evidence :—

Firstly.—In the town of Quilon at sea-level, numerous sandal trees are found growing in several private and public compounds. It is locally believed that His Highness the late Maharaja introduced the species about 40 years ago. In the old palace compound, now converted into public offices, there are 13 trees growing, some of them vigorously, in sandy soil. Their girth measurements at base and associates amidst which they are growing are as below :—

No. of trees.	Basal girth.	Associate species.
1	37"	
2	14"	
3	20"	*Cedrela Toona.*
4	27"	*Eugenia Jambolana.*
5	33"	*Moringa pterygosperma.*
6	28"	*Pithecolobium Saman.*
7	34"	*Artocarpus hirsuta.*
8	27"	" *integrifolia.*
9	27"	*Prosopis spicigera.*
10	21"	*Mangifera indica.*
11	15"	
12	38"	
13	22"	

If it is true that the above trees were planted only 40 years ago, then it must be stated that the rate of growth of some of them has been more rapid than that of trees grown even in their own *natural habitat* on the Salem javadies. Within a few yards of the above compound, *three* dead sandal trees without bark were found standing and their yield of good scented heartwood was as follows :—

No.	Basal girth without bark.	Scented heart-wood in lbs.	Other species found close by.
1	21″	40¾	*Ficus religiosa*, *Ailanthus malabarica* and mango.
2	16¼″	26⅝	*Casuarina* and teak.
3	23″	52⅛	„ and Punna (*Calophyllum mophyllum*).

Secondly.—On the Thirumalai (Jasper hill) near Trivandrum at an elevation of 400 feet numerous sandal plants of different ages are found growing. The species was first planted on the summit of the hill in the compound of a bungalow belonging to the Maharaja in 1864, and it has spread to the slopes and hill foot all round. Having noticed three dying and dead trees on the hill, I felled them with the previous permission of His Highness the present Maharaja in May last and they yielded 79 lbs. of heartwood (unseasoned) as follows :—

No. of tree.	Basal girth.	Scented heartwood.	Associate species.
1	16″	20·2 lbs.	*Erythrina indica.* *Acacia pennata.* *Litsæa zeylanica.* *Phyllanthus emblica.* *Artocarpus integrifolia.* Palvalli (malayalam) an asclepiadaceous creeper, and Peruvelam (malayalam).
2	18″	44·2 „	
3	13″	14·6 „	

On the hills where the trees were felled the soil was dry hard laterite and consequently almost all of the species growing thereon were stunted and stagheaded.

Thirdly.—In the village of Navaikulam, near A ttengal, at an elevation of about 200 feet there are a number of sandal trees and saplings growing along the hedges of private compounds. About two years ago, they were roughly counted by the Forest Department and found to be 490 trees including saplings. I found the species reproducing itself like weeds in some hedges. The Manager of the Jenmi, to whom the village belongs, informed me that a number of trees containing good scented wood were felled prior to 1906 and the sandal utilised for the temple purposes in the village.

There are other places besides the above *three* where sandal trees are found growing at low elevations in the Travancore State. But not having examined them to see whether they contain scented wood, I refrain from mentioning them here.

The foregoing facts and figures establish beyond all doubt *that sandal trees do produce scented heartwood* at all elevations below that of the *natural habitat* of the species in South India even down to the sea-level.

QUILON: M. RAMA RAO,
12th October 1908. *Acting Conservator of Forests, Travancore.*

A VALUABLE DISCOVERY—A PHILIPPINE SUBSTITUTE FOR LIGNUM VITÆ.

The scarcity in the supply of an important wood used by hardwood manufacturers in the United States has created an unexpected opening for a wood from the Philippine forests. It is believed that this product offers a satisfactory and inexpensive substitute for a rare and costly West Indian wood, greatly in demand among manufacturers.

In the past, the forests of the West Indies have produced enough of the wood known as Lignum-vitæ to answer all the demands of the United States manufacturers. It was and is valued

chiefly for its great hardness, its durability, its imperviousness to decay, and its strength; no wood in the world having been discovered with just this peculiar combination of qualities. It is greatly in demand for sporting goods such as ten-pins and bowling balls, for use in shipbuilding, and in fact, for any use where wood of very great hardness, resistance, and weight is required and where wood is preferable to metal.

In 1906, such demands had been made on the West Indian forests for this wood that it was suddenly discovered that the supply of the Lignum-vitæ tree had been almost exhausted. Consternation seized the manufacturers who were constantly making use of the product and they began writing to other parts of the world to learn whether there were other available forests of this valuable tree, and if not, what was the nearest substitute that could be obtained.

One of these letters reached Major Ahern, of the Philippine Bureau of Forestry, requesting information concerning Philippine woods. The letter was from the National Association of Manufacturers with headquarters at New York and stated that having made inquiries in various countries, the manufacturers had been informed that probably the most favorable place in the world in which to find this precious wood, was in the Philippine Islands.

The Bureau of Forestry immediately commenced an investigation and within the past few months experiments have finally proved that a wood answering the requirements of the manufacturers has been found. This wood is called Mancono. Its technical name is *Xanthostemon verdugonianus*, Naves. There is a fortune waiting for the man who will exploit it, for it can be supplied to the New York lumbermen at a fraction of the price at which the product from the West Indies is sold.

The Mancono tree grows in considerable abundance in northeastern Mindanao. Small areas contain almost pure stands of it. It has hitherto escaped the attention of those interested in exploiting the riches of the Philippines and is little known in general trade. The wood is so heavy and hard that it is difficult to cut and the splitting of a log of it is almost impossible.

However it grows in places easily accessible to those wishing to work it, being usually found along steep slopes near beaches whence it can be shipped by water transportation. Also as it is only desired in short lengths, work on it can all be done in the forests where it is cut and the material can be easily handled. Thus the two great drawbacks which attend the marketing of much of the Philippine forest material are done away with; namely, the difficulty of securing land transportation from inaccessible forest districts and the difficulty of securing large numbers of labourers to cut the trees in these inaccessible districts.

The wood of the Mancono tree, even in the tropics where rot and decay are so ready to seize on all perishable materials is practically indestructible. White ants, the curse of the tropics, do not attack it. This quality has already made the wood esteemed by many of the Filipinos in the southern islands who use the cumbersome logs for posts and ground timbers.

Mancono in general however, cannot be profitably logged for lumber owing to its hardness and great weight. It is only the dearth of supply in the world of one of the hardest woods in existence that has brought it into the limelight of public interest.

The heartwood of the tree is uniformly reddish black but after a number of years of seasoning it turns a black walnut color. Like all Philippine hardwoods, it takes a fine polish.

The wood is of such extreme heaviness and density that it sinks in water. For this reason in taking the logs from the beach where they are cut, to the steamer that is to carry them, native boats are required between which the logs are rafted and kept on the surface of the water.

After two years of experiment, in which the Bureau of Forestry is satisfied as to the relative merits of this wood and Lignum-vitæ, the following facts are announced :

(1) The Philippine forests possess a tree whose wood for at least some of the practical purposes required by the lumbermen in America, is equal to that of the rare Lignum-vitæ. It is probably even harder though a trifle more light.

(2) It is found in merchantable sizes and quantities in areas of sufficient extent to warrant its exploitation, and with proper care in cutting the supply may be made to last indefinitely.

(3) It grows in places immediately accessible for cutting and the difficulties of transportation encountered in exploiting many Philippine woods are minimized.

(4) The wood has been used in ship building as a substitute for Lignum-vitæ at the United States Naval Station at Cavite, P. I., and the head of the steam engineering department pronounces it a perfect success after a year's trial. *It has also been satisfactorily tested in* the shipyard of the Bureau of Navigation in Manila.

(5) Most important of all, it can be produced and delivered in New York at a profit for about four centavos a pound while the costly Lignum-vitæ brings from thirty to sixty centavos (fifteen to thirty cents United States currency) for the same amount.

The Philippines should prove attractive for the exploiter of this rare timber. Likewise the hardwood manufacturers of America who are casting about for a substitute of a fast diminishing wood should find it to their profit to purchase the Philippine product, Mancono.

MAURICE DUNLAP,
Collaborator, Bureau of Forestry,
Philippine Islands.

REVIEWS AND TRANSLATIONS.

THE FORESTS OF THE PLANET MARS.

[CONTRIBUTED.]

The learned Abbé Moreux, Director of the Observatory of Bourges, has devoted himself in a special manner to the study of the planet Mars. As the result of his observations, the Abbé has published several pamphlets, and some superb photographs in the papers, which settle the geography of our neighbour, who, unlike the moon, has the good feeling to show us successively every aspect of its surface.

Every one knows that, like the earth, Mars possesses an atmosphere, which, containing a great deal of water, sometimes renders its surface difficult to see. It is also to be remembered *that the atmospheric pressure on the surface of Mars is very slight*, and that, as the result to some extent at any rate of this circumstance, sudden and severe falls of temperature occur in the Martian nights.

The best season for studying the surface of this planet is the summer, when its brilliance is greatest.

The Abbé Moreux thinks that the dark zones of various shapes which are always seen on Mars should no longer be spoken of as *seas* and *canals*, and his reasons tend to give an altogether novel idea of the state of that planet's surface.

The dark spots on Mars appear most often as lines or strips, sometimes indistinct, and generally shading off towards their edges, and attain a width sometimes of 300 or 400 miles. These strips of bluish green colour *shade off gradually* towards the bare portions of Mars, which must in all probability be *deserts*.

The fine bands ("canals") are best seen in the autumn when they *change colour*. This colour passes from bluish *green* to *yellowish green*, then to *orange*, and then to *brown*. Is it not then permissible to suggest that these are not seas, nor rivers, nor canals, but something living—*forests?*

The Director of the Observatory of Bourges says on this subject :—" If we consider that the appearance of these green patches follows very closely the melting of the polar snows, and that moreover their colour changes with the seasons, it becomes evident that we are in presence of a periodical variation, following the succession of the seasons, which is compatible with nothing but the phenomena of vegetation. Green, yellow, orange, brown—these are the very shades of the wonderful range of colours which characterise our own woodlands at the close of the summer.

The Abbé Moreux admits the existence of large valleys (" canals ") running in more or less straight lines, following cracks in the outer crust of the planet's surface, and which must in course of time have become rounded off by erosion.

It is quite natural that the vegetation should have taken refuge in these lowlands, situated between desert plateaux.

Mars is still animated by water—" the vehicle of life "—and the rarefaction of the air is very favourable to rapid evaporation, especially with reference to the vegetable kingdom.

The ground, *too bare*, cools down, *too quickly*, during the nights, and Mars in fact offers an illustration of what our Earth will be when the inevitable gradual drying-up will in course of centuries have done its work, as the result of barbarous deforestation to begin with, and afterwards by the natural course of things. The seas have dried up, producing a desert climate in all its rigour, with extreme variations of temperature, sandy soil, stunted vegetation, and here and there in low-lying spots a few marshes with a very restricted flora.

Do the beings which once populated this Sphere still exist, and have they been able to resist the rigours of such a cold climate? If so, they would do well to arrest, while there is still time, the destruction of that admirable moderator of climate, the forests. They at any rate must no doubt fully recognise what we on this Earth are just beginning to apprehend, that " the forest is the indispensable complement of the creation."—(From an article by R. D. in the *Revue des Eaux et Forêts.*)

BAMBOOS: THEIR STUDY, CULTURE AND USE.

[CONTRIBUTED.]

For all who are interested in bamboos, and especially with regard to their introduction into the parks and gardens of Europe, a small magazine* issued by M. de Lehaie, Ermitage, Mons, Belgium is worth reading.

This little pamphlet, which is illustrated with excellent photographs throughout, contains a great deal of very interesting information regarding the introduction, experimental or otherwise, of all kinds of bamboos into the various parts of Europe. After a brief historical review of the subject, mention is made of the principal parks, gardens and plantations, both public and private, throughout Europe, in which bamboos have now been introduced to any noteworthy extent. Among these, the park of San Andrea in Percussina, near Florence, and that of Prafrance (Gard), in the south of France, are perhaps the most important.

In Belgium also, it appears that considerable attention is paid to the experimental acclimatisation of bamboos, and some very interesting collections are to be found at the Chateau de Marlagne (Namur) at l'Ermitage at Mons, and in many other gardens, where bamboos are made a speciality.

The commercial aspect of this acclimatisation of the bamboo is not to be overlooked, and is dealt with in this pamphlet, which also contains detailed accounts of the cultural measures adopted in Belgium to assist in the growth and development of the bamboo in that country, and to ensure its reproduction. Nearly 150 species of bamboos are dealt with.

* Le Bambou, son Stude, sa Culture, son Emploi.—By Jean Houzeau de Lehaie; published by J. Baudin-Levert, Mons, Belgium; price two francs.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE ROYAL SOCIETY FOR THE PROTECTION OF BIRDS, INDIAN BRANCH.

REPORT FOR 1907.

In writing the Report for the year 1907 the Honorary Secretary feels that some explanation is due to the very small amount of work that he has been able to do, and asks the indulgence of those who have supported the Indian Branch of the Society in the past towards such as has been accomplished.

To keep the aims and objects of the Royal Society for the Protection of Birds before the public, to enlist people's sympathies and overcome their prejudices requires a large amount of spare time. Most Europeans in India have their days and hours more than filled with official work, and anything beyond that has to be done as opportunity may occur.

The present Honorary Secretary is unfortunately no exception and the amount of time he can allot to the Society is altogether out of proportion to what he would like to do. Throughout the early months of the year changes in various Educational Schemes filled every spare moment, then followed a large amount of University Examination work, after which he had to leave for England on urgent private affairs. Returning in November, an effort was made to do something to make up arrears, and to put himself *au fait* with what was going on in India relative to bird and animal destruction.

For these reasons no appeal for subscriptions was made, but as expenses were small, the balance still to the Society's credit is considerable.

The thanks of all well-wishers of birds and animals are due to such papers as the *Indian Field*, *Asian* and *Indian Sporting*

Times. The Jains of Western India and elsewhere have done, and are doing a great deal, especially in attempting to improve the conditions of pinjrapols (animal hospitals).

The £15 granted by the Home Society some time ago to found a small scholarship in the Meerut College has been greatly appreciated, but it is felt that probably the awarding of medals will be more popular, as certain students are sometimes averse from taking small monetary awards. It is proposed, therefore, to try the effect of medals during the present year, and in addition to award a few books as prizes out of the funds at the disposal of the Branch.

The Honorary Secretary hopes to able to obtain from the Home Society some sets of slides for lecture purposes, as he has now the use of a good magic lantern.

A few years ago the rapid diminution in the numbers of certain species of birds in different parts of the world looked as though it would compel "the trade" to indent upon India for a supply of feathers. The writer issued a series of questions and received replies from all over the Peninsula, including Burma and Ceylon. The general purport of the statistics obtained was that, though in certain parts a good deal of damage was being done, taking India as a whole the feather trade had not assumed anything like the proportions it had in many other countries.

The Act prohibiting the export of feathers for trade purposes has evidently taken effect, as not long since an English "Trade" journal inveighed bitterly against the action of the Indian Government in preventing the unfortunate peasant from earning a livelihood during a time of famine by catching birds for the sake of their plumage.

Certain persons have criticised this Act as being of little value It can be, and undoubtedly is, evaded, particularly on the frontier of Portuguese and French territory, and it is true that a good many skins and bales of feathers find their way to Europe by these routes, but it is not at all easy for those who live in remote parts of India to send their goods *viâ* Goa or Pondicherry, and, in spite of a certain amount of leakage, the enactment has put a distinct damper on the feather-dealer.

A further supply of these questions is being sent out in the hope of getting statistics enabling the present position to be compared with that before the Act came into operation. Enthusiasts in Europe may regret that more police supervision is not exercised, but all who know the conditions in the East are aware that more harm than good would result therefrom.

As has often been remarked the actual wearing of birds feathers would cause but little protest were it not for the abuses which seem inseparable from supplying the market. The slaughter of many species during the breeding season has been so ruthless, and has been carried out with such cruelty that it has been impossible for it to pass unnoticed.

The ornithologist views with pain the extinction of beautiful and interesting creatures, while the economist and agriculturist sees with alarm the disappearance of birds which may happen to be the natural enemies of insect pests, and thus possibly upset the balance of nature.

So far as the destruction of game is concerned, a large number of municipalities in India have local bye-laws, but they are often more or less a dead letter unless the Magistrate happens to take special interest in the matter.

Fortunately for the birds most Indians are vegetarians. Mahomedans, Christians, and many of the lower castes will eat meat when they can get it, but as it is beyond the means of the poorer classes as a rule, the demand is not sufficiently great in the hot weather when most of the "Plains" birds breed. Duck and teal are brought to market so long as any remain, but the majority are away to the north by the end of April. A few partridges are brought in occasionally, but the quail—such a standing dish in India—is kept in quaileries and fattened like the domestic fowl. In the "Hills" unfortunately a large number of pheasants and partridges are shot on their nests—particularly near hill-stations—and sold to hotel and boarding-house proprietors. The risk of detection is so small and the punishment if caught so inadequate that there is very little to deter the man who would make a little by supplying the market.

To sum up, the higher Hindu castes and the Jains are strict vegetarians, and the great majority of Mahomedans, low-caste Hindus and Native Christians are practically so from motives of economy. Moreover the "Arms Act" restricts the number of fire-arms which can be used against birds and animals. These causes combine to check the rapidity of diminution in our fauna which would take place were our large and increasing population of the same habits and possessed of the same weapons as the European. Nevertheless diminution is proceeding, much more so in some parts than in others, and though this may appear slight, yet, if things are allowed to pass unnoticed, evil may be done which may be difficult to remedy.

In certain parts of the country there exist tribes which from time immemorial have been hunters. The Bhils and Gonds amongst others have become famous for their skill as shikaris. The Gurkhas and many hill tribes are no mean sportsmen, though their methods, particularly the wasteful snow driving, do not commend themselves to our ideas. In Northern India the Gujars and Kunjars, Pasis and Ahirs destroy numbers of birds and animals; the damage caused by the two former tribes is often only to be compared with that done by wild dogs.

But while in former times frequent war, pillage and social disturbance restricted the tracts occupied by these people and prevented their numbers from increasing, conditions have changed under the Pax Britannica.

The risks of war being eliminated the tribes have spread beyond their accustomed limits, and the Gujars wander all over the country netting and destroying everything in those tracts which are unfortunate enough to attract them. Not very long ago the Honorary Secretary received information regarding, wholesale netting by these people in the Ganges "Khadir" and similar localities; and once they start operations they rarely leave much behind in the place they have selected for their patronage.

The advance of civilisation has not been forgotten in seeking an explanation for disappearance of certain forms, but these are chiefly the larger animals, and do not strictly come within our limits.

Thus the lion has become practically extinct and the bear and panther are rare now in many places, where they formerly abounded. The railways as they open up the country bring large European and Eurasian staffs which rapidly thin the herds of blackbuck and chinkara (gazelle). Amongst the birds the decrease is chiefly noticeable in the water birds which, as the jheels they frequent are drained and turned into arable land, return no more to their former haunts.

Attention is drawn to the Gold Medal of the Royal Society for the Protection of Birds together with twenty guineas which are offered by the Society in England for the best essay or Treatise on "Comparative Legislation for the Protection of Birds." Copies of the regulations guiding the competition have been sent for from England and will be forwarded to anyone who asks for them.

The Honorary Secretary appeals to those who take an interest in the fauna of India for subscriptions and donations, however small, to carry on and extend the work. Funds are required for printing, advertising, postage and the usual expenses incidental to work of this nature. A clerk is wanted to carry out the office work, as it is impossible for the present Secretary to carry on the correspondence himself with anything like proper regularity, but until finances are better it is impossible to employ one.

It was found at first that a large number of persons were deterred by the idea that the Society looked askance at followers of Sport and Natural History, and it has been no easy matter to eradicate this impression.

The only rules that are binding on members are—

(*i*) That they shall discourage the *wanton* destruction of birds (and animals) and interest themselves generally in their protection.

(*ii*) That they shall refrain from wearing the feathers of any bird not killed for food, the ostrich only excepted.

(*iii*) That they shall endeavour to recognise fully the breeding seasons of the various species and refrain from sport at those times. (This is not intended to prohibit naturalists from indulging in their several pursuits, but it

is taken for granted that their innate sense of what is right and proper will cause them to act with moderation.)

(*iv*) That they shall endeavour to act as becomes true sportsmen and lovers of nature and to induce others to do the same.

MEMBERS.

Any person may become a member of the Society, on paying the sum of two annas as registration fee and agreeing to the objects of the Society as stated in the rules.

ASSOCIATES.

Members may become Associates of the Society on agreeing to pay one rupee or more annually, and Life Associates, a donation of one gold mohur.

Associates who subscribe five rupees and upwards annually and donors of five gold mohurs will receive a copy of each new publication as issued.

Subscribers of one gold mohur annually will be designated Fellows.

It is to be hoped that all sportsmen, naturalists, and lovers of bird and animal life will be induced to lend their influence and financial aid—the smallest subscription and donation—to enable the Society to defray the few necessary expenses.

The number of letters and communications that have to be written before individuals make up their minds to join is very great, and numbers of circulars and letters have to be despatched to which no answer is vouchsafed. Such work should really be carried out by a clerk, but until further funds are forthcoming, it is impossible to employ one. In the meanwhile every advantage possible must be taken of the means at our disposal.

It is to be hoped that those who had supported the Society this year will not only not withdraw their aid, but will endeavour to further its aims and objects by inducing others to join. The Royal Society for the Protection of Birds, which in India also includes wild animals generally, does not propagate the views of a

few faddists, but endeavours to prevent by reasonable means the extermination or undue diminution of our Indian fauna.

Subscriptions and donations may be paid to the Honorary Secretary.

WILLIAM JESSE,
Honorary Secretary,
Royal Society for the Protection of Birds,
Meerut College, Meerut. *Indian Branch.*

EXTRACTS FROM OFFICIAL PAPERS.

MEMORANDUM ON FOREST SURVEYS IN INDIA.*

BY LIEUTENANT-COLONEL P. F. GORDON, I.A.

1. The Forest Survey Branch was created as a separate agency for Forest Surveys in 1872. The Branch was placed under the control of the Inspector-General of Forests and Captain E. Bailey, R. E., then a Deputy Conservator of Forests in the North-West Provinces, was appointed Superintendent of Forest Surveys and Working Plans.

Prior to the formation of this Branch it had been found that the ordinary small scale topographical maps were unsuitable for the purposes of forest administration, and it became necessary in many cases to supplement these maps by others on larger scales; these were produced by local or provincial agency, but want of uniformity of scale and style impaired their use and, even when sufficient for local requirements, they were useless for geographical purposes, and their value was quite incommensurate with the cost of their production.

2. From the outset the Government of India insisted on the necessity for placing the work of the Forest Survey Branch under competent professional supervision with a view to its field surveys

* This appeared as the Appendix to the General Report on the Operations of the Survey of India during 1906-07.

being made suitable for incorporation into the standard maps of India.

To show the importance attached to this supervision the following note regarding the formation of the Branch made by the Secretary to Government may be quoted :—"......the Branch so far as its pure surveying work is concerned must work strictly and absolutely in accordance with the rules of the Imperial Survey Department and be subject, in all matters of professional detail, to the guidance of the Surveyor-General in such wise as to satisfy him that he may safely accept in his own maps the geographical details furnished to him (at such time and in such form as he may prescribe) by the Forest Surveys. I consider this of such importance that I cannot now move further in the matter until the papers have been laid before Colonel Thuillier and Captain Bailey shall have satisfied him that in all these respects everything will be done entirely to his satisfaction."

In 1873 the Duke of Argyll, then Secretary of State for India, while approving of the formation of a Forest Survey Branch, remarked on the importance of connecting Forest Surveys with those under the Surveyor-General in order that they might be capable of reduction and of being used for geographical purposes. With this object in view Colonel Walker, R.E., F.R.S., Superintendent of Trigonometrical Surveys, was asked by the Government of India to assist and advise in the work. Captain Bailey repeatedly acknowledged the great benefit he had derived in organising the Branch and in carrying out its operations from Colonel Walker's assistance and advice which were at all times readily afforded. In 1876 the Marquis of Salisbury, then Secretary of State, in the course of a despatch on the subject, noticed with satisfaction that the co-operation of the Superintendent of the Great Trigonometrical Survey in the work executed had been of value.

Colonel Walker, in submitting the annual progress report of the Forest Survey Branch for 1876-77 to the Government of India, placed on record that the maps produced by the Branch were well suited for reduction and incorporation into the standard map of India on the scale of one inch = one mile executed by the

professional Survey Department. He also remarked that the principal object which was originally contemplated had been satisfactorily accomplished.

In 1878 Colonel Walker was appointed Surveyor-General, and the Government of India requested him to exercise, as Surveyor-General, the same professional supervision as he had hitherto exercised as Superintendent of the Great Trigonometrical Survey.

3. The annual progress report of the Forest Survey Branch was until 1877 submitted to the Government of India by the Superintendent, Great Trigonometrical Survey, and from 1878 to 1893 by the Surveyor-General. From 1894 the report on the operations of the Forest Survey Branch was incorporated in the General Report of the Survey of India and has continued to be so incorporated up to the present time. The Superintendent of Forest Surveys continued however to submit a special report giving a more detailed account of the work which was published annually.

4. In the early years of its existence the headquarters of the Forest Survey Branch was located in various private houses hired as offices. It was soon realised that this arrangement was unsuitable and Dr. Brandis, then Inspector-General of Forests, writing in 1875, remarked :—"It is essential that all original maps and records be kept permanently in one place guarded from risk of fire and insects and that they should be kept in systematic order so as to be readily accessible......for this purpose a permanent Forest Survey office is necessary......eventually it may be an advantage to build an office in the vicinity of the Great Trigonometrical office."

This hope was not realised until 1903 when the present office was built in the compound of the Great Trigonometrical Survey office at Dehra Dun.

5. From the commencement the rules regarding the apportionment of the cost of Forest Surveys were somewhat complicated. In 1888 the Government of India laid down definite rules whereby a certain proportion of the cost of Forest Surveys executed by the Survey of India should be borne, in respect of the value of the

work for topographical purposes, by the Survey of India and balance by the Forest Department. The proportion was regulated by the proportion of forest area to the whole area under survey by a party, and also by the scale of survey. These orders were amended on various occasions until finally in 1904 one uniform rule was applied to the whole of India whereby 70 per cent of the cost of Forest Surveys was to be borne by the Forest Department and 30 per cent by the Survey of India.

6. The necessity for good maps for general forest administrative purposes and more especially for the preparation of working plans is fully recognised in all countries where the management of State forest is carried out on scientific principles. The question of the most suitable scale for forest maps has always been one on which there has existed a great difference of opinion. In Europe forest maps are prepared on very large scales, but the case is not on parallel lines with that of India, as in Europe the maps are almost solely used as legal documents in connection with the record of the boundaries and not, as in India, for working the forests. When the Forest Survey Branch was organised Conservators of Forests were consulted as to what scale should be adopted: their opinion differed widely: the 4-inch, 8-inch, and the 16-inch all had their supporters, but on the whole the 8-inch was the scale preferred by most of those consulted.

There were, however, many objections to this scale being adopted, such as the enormous cost of the survey and the unwieldiness of the maps, and it was finally decided with the approval of the Superintendent, Trigonometrical Surveys, to adopt the 4-inch scale and this scale, with certain exceptions, became the standard scale for Forest Surveys in India. This decision is upheld by the late Mr. D'Arcy who, in his "Notes on the preparations of working plans" published in Calcutta, 1892, states that a scale of 4-inches to a mile is the largest that is generally required in India. The 16 inch scale was adopted for babul forests of small area in the Deccan and the 8-inch for the teak forests of the Konkan where the intensity of the working required maps showing all possible detail with the greatest accuracy. In both these instances the value of

the forests justified the expenditure. In the Thana district of Bombay a 4-inch survey which was made between 1881—85 was found inadequate and a survey on the 8-inch scale which has just been completed was demanded.

7. In several instances it was thought that a mere boundary survey would serve the purposes of forest administration, but such surveys have almost invariably had to be replaced by detail surveys. Such boundary surveys are principally useful in checking encroachments, and in the Central Provinces most of the Forest Surveys have been supplemented by an additional boundary survey on the 16-inch scale for comparison with village maps.

8. The training of Forest Officers in survey work was part of the original scheme for a Forest Survey Branch, and during the early years of its existence many officers of the Forest Department were attached to the Branch. In 1878 the Forest School was established at Dehra Dun and Captain Bailey was appionted its first Director in addition to his other duties as Superintendent of Forest Surveys: as his duties as Director occupied most of his time much of the work in connection with the supervision of the Forest Survey Branch devolved on his Assistant, Mr. W. H. Reynolds, who was eventually in 1883 appointed to succeed him as Superintendent. Mr. Reynolds continued in charge until 1900 when on his retirement he was succeeded by Captain P. J. Gordon, I.A., Deputy Superintendent, Survey of India, who continued to hold the appointment until the Forest Survey Branch ceased to exist on the 15th October 1906.

9. On the 1st April 1899 No. 20 Party, Survey of India, which had been employed on Forest Surveys in Burma was amalgamated with the Forest Survey Branch and the Branch, which had hitherto been under the administrative orders of the Inspector-General of Forests, came under the general and professional control of the Surveyor-General.

On the 1st April 1904 the Governments of Madras and Bombay having accepted the suggestion of the Government of India that the Forest Surveys in these Presidencies should come under the supervision and professional control of the Superintendent,

Forest Surveys, the Branch was reconstituted under the designation of the Forest Survey Branch of the Survey of India and all its establishment reverted or was transferred to the Survey of India. The expenditure on Forest Surveys throughout India was by the same resolution distributed in a uniform manner, 30 per cent to Topographical Surveys in consideration of the value of the work in the preparation of standard maps, and 70 per cent to Forests.

10. The Branch as reconstituted consisted of No. 9 Party employed in detachments in various parts of India, where there was not sufficient Forest Survey work for a complete party, No. 17 Party in the Bombay Presidency, No. 19 Party in Madras and No. 20 Party in Burma. The Drawing and Map Record and Issue Office continued as before at the headquarters of the Branch at Dehra Dun.

11. In 1904, the Indian Survey Committee, appointed to consider among other matters, the methods and expenses of surveys and the organisation of the Department, recommended that special Forest Surveys should cease as a general rule, and, where required on scales larger than those of the regular topographical, their cost should be debited to the Forest Department.

This recommendation being in conformity with the views of the Surveyor-General and of the Inspector-General of Forests, it was decided that the various parties constituting the Forest Survey Branch should be absorbed and employed for the future on Topographical Surveys.

On the 15th October 1906 the post of Superintendent of Forest Surveys, in accordance with another of the recommendations of the Committee, lapsed, and the Forest Map Record and Issue and Drawing Offices were placed under the charge of Mr. C. F. Erskine, Deputy Superintendent, Survey of India.

12. In the future it is proposed that all forests occurring in sheets coming within the regular programme of the Survey of India shall be surveyed either on the scale adopted for the sheet or, if required, on any other scale up to 2 inches = 1 mile, and also that, when required, an additional boundary survey of such

forests on the 4-inch scale shall be made without any extra charge to the Forest Department, but that when any surveys are required outside the regular programme of the Survey of India, or on scales larger than 2 inches = 1 mile, the cost of such surveys shall be paid for entirely by the Forest Department.

13. Among officers who have been intimately connected with the Forest Survey Branch the following may be mentioned in addition to the Superintendent already referred to :—

Mr. H. C. Hill, afterwards Inspector-General of Forests, who was attached to the Branch from 1874 to 1878.

Mr. E. F. Litchfield, Deputy Superintendent, Survey of India, who was attached from 1875 to 1895.

Mr. Chill, who belonged to the Branch from its formation until his death in 1888; Messrs T. S. Marten, J. Marten, Hughes, Nichol and C. Litchfield of the Survey of India were all employed for long periods.

This record would not be complete without more than a passing reference to Mr. A. Descubes who joined the Branch in 1887, and was soon afterwards appointed Superintendent of Forest map records. The care and up-keep of the map records of the Forest Department has been under his charge since he joined and most of the working plan and other special maps of the Forest Department which have been published have been compiled and prepared by him.

Among the subordinates the Head Clerk, Babu Kalikanth Kar, the Head Computor, Babu Badri Datt, and Surveyors Tulsi Ram, Odey Singh and Bhup Singh Bist, who have spent their whole service in the Branch, deserve special notice.

14. 68,424 square miles of forests or nearly two-thirds of the total area of reserved forest in India have now been surveyed in the 4-inch or larger scales : much of the remaining area consists of forests, the value of which is not considered sufficient to justify the expense of a special survey.

15. The first survey undertaken by the Forest Survey Branch was that of the forests of Dehra Dun on the 4-inch scale, the survey of the plains portion being carried out during the same

period by the Survey of India. This survey was conducted on ideal lines as both departments worked in close connection with one another, each confining its operations to its own legitimate sphere; the principal object which was originally contemplated in associating the Forest Surveys with the Trigonometrical Surveys was here most satisfactorily fulfilled and the resulting maps, although prepared over thirty years ago, still answer their purpose. Until 1879 the operations of the Forest Survey Branch were almost entirely confined to the United Provinces and Oudh, but from that year until the present time its operations have extended to every Province in India.

Various Revenue and Topographical parties of the Survey of India have also been employed since 1878 on Forest Surveys in the Punjab, United Provinces, Bengal, the Central Provinces, Burma and in the Madras and Bombay Presidencies.

16. The following table gives in detail the forest areas surveyed in various forest divisions on the 4-inch and larger scales :—

Detail survey on 4-inch scale and larger scales of Forest Reserves on 30th September 1906.

Province.	Circle.	Area surveyed up to 30th September 1906.
		Sq. miles.
Bengal	Bengal	2,563
United Provinces of Agra and Oudh.	Eastern Circle	2,050
	Western Circle	1,999
	Total ...	4,049
Punjab	Punjab	3,398
	Jubal-Taroch	170
North-West Frontier Province	North-West Frontier ...	366
Central Provinces ...	Northern Circle ...	7,788
	Southern ,, ...	7,268
	Berar ,, ...	3,142·5
	Total ...	18,198·5

Province.	Circle.	Area surveyed up to 30th September 1906.
		Sq. miles.
Burma	Northern Circle ...	3,210
	Southern ,, ...	3,061
	Tenasserim ,, ...	3,213
	Pegu ,, ...	2,918
	Total ...	12,402
Eastern Bengal and Assam ...	Eastern Bengal and Assam ...	985
Ajmer-Merwara	Ajmer-Merwara ...	142
Madras	Northern Circle ...	4,110
	Southern ,, ...	5,171
	Central ,, ...	5,347
	Total ...	*14,628*
Bombay	Northern Circle ...	2,345
	Southern ,, ...	4,671
	Central ,, ...	4,507
	Sind ,, ...	...
	Total ...	11,523
	Grand Total ...	68,424·5

17. Attempts have been made in different Provinces to utilise the services of the surveyors for the purpose of keeping up a record of soils and forest growth, but owing to the want of expert knowledge on the part of the men, such records have proved of little value.

18. A critical examination of the cost-rates of forest surveys in different provinces and by the various agencies would be out of place here; nor would it serve any useful purpose. The cost-rates are influenced by so many considerations outside the actual professional work of the surveyor that comparisons would be misleading.

Forest maps are issued free of cost to Government Departments: each edition consists of from 50 to 100 copies and as each edition is exhausted a new edition embodying all changes in boundaries is published. The maps are available for sale to the general public, but there is little demand for them.

FORESTS AND WATER-SUPPLY.

Addenda to the Forest Department Code, No. XLIII, dated 10th August 1908.

It is indeed satisfactory that the additions given below have now been made in the Working Plan Syllabus *re* the regulation of the water-supply as an object to be attained and that additional information is now required on this subject. These appear to us to be the most important code rulings which have issued for many years and it is much to be regretted that they were not in force 35 years ago.

Article 89 (1).

PART II OF SYLLABUS, PAGE 41.

After sub-section "Object sought to be attained" add the words :—

(*a*) As regards the improvement and regulation of the water-supply.

(*b*) As regards the yield of forest products.

After sub-section "Method of Treatment adopted" add the words "in order to attain the above objects."

After sub-section "(1) General scheme" under "Miscellaneous," add a new sub-section as follows :—

"Yearly record of spring levels, of rainfall, of width of beds, of streams and torrents and of high and low water therein."

Article 89, *page* 43.

After explanatory note vi, add a new note as under :—

(vii) It is desirable that a careful examination and report should be made of the present and the possible influences of the forest tract upon the climate and

water-supply of the country ; that the objects sought to be attained in the management of the area should be *fully specified and that the treatment* prescribed should be in accordance therewith. It is also of importance that the collection of data and upkeep of records should be continuous and accurate. With this object suitable localities for the measurement of spring levels and of *rainfall should be specified and* the erection of permanent benchmarks from whence bearings can be taken in order to record alterations in width of waterways and in variations of high and low water should be prescribed. The Working-Plans Officer will during *his inspection of the area compile a list of* water-courses originating in or flowing through the forest, giving a short description of each and noting whether the water-supply is perennial and its approximate volume at the time of his visit.

SIR H. E. MAXWELL ON FOREST RESOURCES.

In connection with the meetings in Edinburgh of the Royal Scottish Arboricultural Society, the Right Hon. Sir Herbert E. Maxwell, Bart., gave an address last week in the Concert Hall of the Scottish National Exhibition on "The Forest Resources of the United Kingdom." The chair was first occupied by Sir Kenneth J. Mackenzie, Bart., of Girloch, the President of the Society, and afterwards by Mr. John Methven, one of the Vice-Presidents. The lecture was illustrated by lantern views.

Sir Herbert Maxwell said he felt that in undertaking to lay before them in the space of an hour a view of the present condition and an estimate of the capabilities of British woodland, he was attempting to get a gallon into a quart pot. The utmost he could hope to do was to convince them of the great loss incurred by the State and private owners by their neglect of sound principles of

forestry, and the urgent need for a speedy reform in the management of our woods. The urgency of the matter arose from three causes, namely —(1) the rapidly increasing demand for timber in the United Kingdom; (2) a corresponding increase in the consumption of timber in certain other countries; and (3) a serious diminution in the available timber supply in all accessible parts of the world. If anybody thought that there was no cause for anxiety, that it did not matter where we got our timber so long as we were able to pay for it, let him lay to heart the warning uttered by the Departmental Committee on Forestry, who reported in 1903:—"The world is rapidly approaching a shortage, if not an actual dearth, in its supply of coniferous timber, which constitutes between 80 and 90 per cent of the total British timber imports." Coniferous timber rose 22 per cent in price during the twenty years from 1885 to 1905. A plentiful supply of coniferous timber was indispensable to all our principal industries. How many of these industries could be carried on at a profit if in the next twenty years timber rose another 22 per cent? And everything pointed to such a contingency. There was a rapidly growing demand for an article of which the supply was running short. Some of our former sources of supply were already cut off. Thirty years ago we were drawing large supplies of timber from the German Empire. During that period the industrial expansion of Germany had been so great that, although the annual value of her forests was reckoned at 22 millions sterling, she now required every stick of it for her own consumption. Not only so, but she had entered into competition with us as a purchaser, importing about 4,500,000 tons per annum of foreign timber, valued at £15,000,000. As with Germany, so with the United States and Canada, where the forests were long considered to be inexhaustible, and doubtless would have proved so but for reckless lumbering. In all the circumstances, it was difficult to conceive anything more economically urgent than that steps should be taken without delay to develop our own neglected forestry resources.

Very few, indeed, were the British landowners who could show a profit on the year's management of their woods. Were it

possible to ascertain the facts relating to the whole three million acres, it could not be doubted that they would show a very heavy deficit. They had the facts relating to the Crown woodlands in his country. The balance-sheet of the Office of Woods and Forests for 1903-04 showed, under the heading of "Royal Forests and Woodlands," a revenue of only £32,481, against an expenditure of £58,402, a net loss of £25,911. They were not to suppose that he was casting any blame on the Commissioners, who had administered the woodlands in the past according to the instructions of Parliament, namely, as a mixture of pleasure ground, common grazing, and amateur forestry. He was glad to recognise that since Mr. Stafford Howard became Senior Commissioner he had been successful in persuading the Treasury to initiate a better system, the first fruits of which was the purchase of 13,000 acres in Argyllshire as a demonstration area. A comparison with the German forests showed that if British forest management were as successful as German, the three million acres of woodland in these islands, instead of costing enormous sums to maintain, should return an annual net profit of a round million, or 6*s.* 8*d.* an acre.

Mr. R. C. Munro Ferguson, M.P., in proposing a vote of thanks to Sir Herbert Maxwell, said it might be taken as an earnest of the intention of the Government to have forest waste lands in Scotland, but what they needed before they embarked upon afforestation in Scotland upon a great scale was a demonstration forest, where a new generation of foresters could be trained for practical sylviculture. A demonstration forest was the great need of the United Kingdom at the present time. He saw that recently some feelers had been thrown out as to the expediency of loans to private owners in Scotland. He did not think that was a very practical proposal, when they could buy land at £2 an acre, and under the State could far better plant the land and secure a continuous good management without which no tree planting could be a success. Before they had tree planting on a great scale, they must have an adequate system of training. He thought Sir Herbert Maxwell's lecture would do a great deal to enforce upon the public mind the need for action, and well thought action, on the

part of the State itself. The State was very anxious to have its finger in every pie. There was certainly one direction in which individual management had been a failure, and that was in sylviculture, yet it was in sylviculture where all Governments in our history had shown themselves equally incompetent to take collective action.—(*Timber Trades Journal.*)

THE FOREST OF THE IVORY COAST.

In *La Geographie* for March 15th, M. Aug. Chevalier gives an interesting account of the virgin forest which forms a coastal belt along the Ivory Coast and is continued into the Gold Coast and Liberia on either side. Much of this forest is still unexplored, and progress through it is excessively difficult. Here man is completely subordinated to the dominant plant life, and can move but little from his native village. The villages are connected by tracks which are very faintly marked and very difficult to traverse, and which differ very little from the many monkey tracks which cross them in all directions. Like the wild animals of the forests, the human inhabitants find in it everything necessary for life—food, clothing, and shelter. Agriculture is reduced to its simplest form. Small quantities of bananas, manioc, taro, rice, etc., are cultivated, but the forest speedily reinvades the cleared patches and the people have remained at a very low level of evolution. The geological composition of the area is very difficult to study, for surface erosion seems to be at a minimum and the rocks are very rarely exposed. The study of the hydrography of the region is also excessively difficult, for the streams have no well defined beds. Their banks are bordered with an almost impenetrable fringe of spiny climbing palms, and at the rainy season they inundate all the surrounding low-lying country. In the dry season again, the streams may be so completely dried up that their position is difficult to trace; the courses of the minor streams are indeed often very vague, the water in the rainy season meandering through the forest. The whole condition described by M. Chevalier is extraordinarily interesting as showing at its maximum

the protective nature of the forest in relation to the forces of erosion.

The limits of the forest are well marked and it proves to be less extensive than the difficulty of traversing had led previous observers to believe. In the Ivory Coast it covers about 120,000 square kilometres, and extends northwards to 8° N. in the region of the Upper Cavally, and to about 7° 30′ N. in the basin of the Comoe, but is constricted in the centre by a deep V-shaped region, enclosed by the Bandana and its tributary the Nzi, where the Savanna region encroaches upon it. On this northern border the dense forest passes into a bush region, with numerous "gallery forests" along the course of the streams, and scattered brushwood which gradually passes into the true Savanna of the Sudan. Southwards the forest dies away at the border of the coast lagoons, or at the sea where the lagoons are absent. Near some of the shore lagoons however certain curious non-marshy Savannas intervene, whose origin is unknown ; they do not appear to have originated in the destruction of forest and are not used for cultivation.

As to the composition of the forest, it may be said to form three tiers. The uppermost consists of the high trees, usually 30 to 35 metres in height, which are bound together by lianes so that a continuous vault of green is formed. Through this sea of foliage individual trees of 40, 50 or 60 metres in height emerge to the daylight. Beneath this vault lies a second story of partially etiolated trees, of less height, while below them is a third story, consisting of shrubs and herbaceous lianes which is so compact that the light which penetrates to the soil is excessively faint. The surface of the soil is therefore in general bare, with here and there a few small climbing plants whose violet leaves are adapted for catching the last rays of light. Dead leaves are rare for they are attacked by termites or fungi as soon as they fall, and so destroyed. One of the surface fungi produces a phosphorescent mycelium, which in the rainy season covers all dead vegetable matter, so that at night the soil of the forest glows with a faint light. As to individual trees palms are abundant in individuals but not in

species. The cocoanut palm is not indigenous and occurs only near the villages, never in the forest ; the oil palm also, although common, appears to always occur in the vicinity of cultivated ground, or as an escape. On the other hand, *Raphia* palms are very abundant, as are also the liane-palms like *Calamus*, whose spiny branches form one great obstacle to progress in the forest. The chief products of the forest are oil from the oil palm, rubber, and cabinet woods. The last are as yet insufficiently exploited and form the great hope for the future. Kola nuts also offer a valuable field for exploitation.—(*The Scottish Geographical Magazine.*)

SCHOOLS OF FORESTRY.

There has recently been some writing and correspondence upon the subject of so-called forestry schools, and we gather from it that there is growing up a class of young and earnest men who take the subject of the management of woodlands seriously, and who have determined to advance under the progressive teaching now so prevalent. This is, perhaps, one of the best signs of progress in a branch of rural economy which is so essential to the well-being of landowners and of the nation as a whole. We welcome the advent of these young and vigorous men, and we feel sure that when their zeal is tempered by experience they will do much good work. There would appear to be three schools—(1) the continental, (2) the progressive, and (3) the old or British school; but in our opinion there is one only—the forest school. Surely we are all progressive, for everything points to progress. If we are not, we may as well step out of the ranks and give place to better men. The old forester has acquired by long experience a fund of knowledge which the most advanced student may do well to study, and if he has not fully accepted the new methods and ideas it is due not to unwillingness, but to an inability to graft it on to the stock which has become to him a dogma. He is old, however, and is giving way to the younger men—young, active men imbued with enthusiasm, who are keen to learn and keen to adopt. The chief strength of these men lies in the fact that

they are willing to learn. The old men were until lately unwilling to accept new theories and methods, because they thought they knew all there was to learn. We are on the eve of great accomplishments in respect of forestry, and this is due to a combination of effort manifested by individuals and societies. The Surveyors' Institution, through its examinations, has done much to foster enterprise; the arboricultural societies have by their enthusiasm infused into the minds of both foresters and agents a desire to learn; and so it goes on year by year.

The introduction of continental methods is chiefly due to the facility of travel, the excursions rendered possible by united effort, and by the spread of scientific research. The ball of experience is rolling up, and will continue to roll, if it be not hindered by this separation of schools. If we are wrong in admitting but one school, we are at least right in maintaining that the progressive, as a separate school, must press on, for neither the continental nor British schools will usefully continue without progress. The continental school is an excellent one, and it cannot be too deeply studied, and British foresters will do well to skim off the cream, to graft the best of its scions upon our old stock. By it we shall gather strength, and in ages to come the effect will be visible. It must, however, be borne in mind that this continental school has grown up upon a very different foundation to our own, and, though adaptable in part, is not adaptable as a whole. The foundation is a State ownership of forest areas and of State control, and from this has arisen a continuity of management which is the keystone of success. In some continental States this State control influences private ownership, so that the Continent becomes practically national and almost universal. This tends to a maintenance of a timber supply and a regularity of revenue. In our own land this cannot be; at least, our most advanced reformers can hardly see a change in our land system of this magnitude—a change which will throw the management of woodlands into a department of State. From what we have seen on the Continent we are led to believe that waste is minimised, and that timber when ripe is cut for use. In this we suffer as a nation and it is due partly to our lack

of system, and partly to our erratic or irregular course of management. Walk where one will through our woodlands and agricultural districts, and we find dead and dying trees—trees which should have been reaped years ago, and which would have been under the French system. Here, surely, is a case where we may learn from our neighbours. The love of old trees is so deeply engrained in the hearts of our landowners that to cut them is sacrilege. They are apt to forget that such a course is not only a throwing away of capital, but a source of future loss through the spread of fungi and insect pests. We have endeavoured for years to drive this nail home, but the wood is tough—the wood of prejudice and custom.

When is timber ripe? When should it be cut? It is ripe and fit to cut "when it has attained the maximum of utility for its proprietor." This is a sound maxim which every landowner should take to heart. Until a working circle is adopted there will be erratic management, and this, we believe, is being absorbed by the principals who are responsible for the well-being of our forest areas. It is one of the signs of progress, one of the signs of the grafting into our system the best of that which is termed continental. A working circle, however, can only be successful where there is a continuity of control; it may improve our system, but its endurance is doubtful. Take an estate in Great Britain, with its mixed woodlands and under its present system of management, and endeavour to lay down a plan of a working circle. It will break the heart of a theorist and try the patience of an expert. It cannot be done *in toto*, but it may be done in part, and if only partially successful will be useful and beneficial. A working circle implies the presence of a system based upon universal and immemorial usage. Progress, however, is visible to all who are willing to see it—to all who are not prejudiced. And, further, this progress is not slow; it is moving rapidly, and with beneficial results. The question as to pure planting, mixed planting, under planting shade-bearing and light-loving trees, and the best methods of realisation are each and all evidences of thought. They each possess merits, but the adoption of them cannot under any conditions be rendered universally applicable. What is suitable under one

condition may not be suitable in another. Each forester must work out his own line of action according to the circumstances of the case, and the forester who endeavours to carry out a system which he believes to be sound through his theoretical learning only may find himself a failure. A forester is not in the position of a farmer or a gardener, who reap their crops within the year; he plants and controls for future generations, and it is essential that he should look ahead as far as he can in order to see what the result of his labour is likely to be. In this he often fails, which is manifest in wrongly selected trees, in distances apart, in thinning of young plantations, and in his failure to recognise probabilities. This, too, is being rectified, for foresters are keenly alive to the national benefits likely to accrue through foresight and skill.

Progress is evident in the selection of the Japanese larch for future planting, in the selection of other hardy coniferæ, and in many changes of a minor character. One of the chief disappointments is in the failure of larch plantations, which has become so prevalent, which has led in some cases to the abandonment of planting. This we believe has been met by the introduction of the Japanese larch, for out of the areas we have planted there has so far been no failure, no disease, no injury due to *Chermes laricis*, and no sign of lassitude. What may be, we leave to the future, but we recommend its adoption, advising would-be planters at the same time to be sure that they are supplied with the genuine article. This is only one of the many possibilities open to landowners and foresters whereby they may add to the timber supply and to the prosperity of their estates. The difficulty lies in overcoming the unwillingness of landowners to invest in what must be a deferred benefit. Induce them by substantial aid to do this and the effect will become national. Statistics—a branch of advanced forestry—render it clear that the world's timber supply is diminishing, and if this be correct, as it doubtless is, there can be no question of ultimate success if the planting be well conceived. Let the forest schools unite, and talk less of continental methods, progressive methods, old and worn-out belief, and by adopting the best of each advance British forestry.—(*The Field.*)

FORESTRY IN HUNGARY.

Although dwarfed and overshadowed by Shepherd's Bush the Hungarian Exhibition at Earl's Court is one that is both uncommonly instructive and well arranged, and this is more particularly the case with regard to the sections dealing with agriculture, horse breeding, and forestry. The exhibits in the last mentioned branch of rural economy are, indeed, so interesting that it is a pity they cannot be retained permanently in this country for the benefit of students of forestry. Now that State afforestation is one of the economic questions receiving a good deal of public attention, and that so much has been done within the last five years for technical instruction in forestry at most of our universities and agricultural colleges, it may be of interest to cast a glance at the forestal conditions in Hungary, as illustrated by the exhibits to be seen at Earl's Court.

In Hungary forestry is regulated by laws passed in 1879 and 1898, the principal objects of which are (1) to ensure the maintenance of protective woodlands on mountain tracts and hill slopes for the protection of the lower lying agricultural lands against landslips and avalanches, and (2) to bring under official control and supervision, with a view to their proper management all woodlands on non-agricultural tracts belonging to the State, local authorities or corporations, and ecclesiastical and other trusts regarding common or entailed estates. Each forest thus under official supervision can only be worked in accordance with a plan approved by the Agricultural Department and carried out by properly qualified forest officials. In the purely protective woodlands felling is strictly prohibited, while in all the areas under economic management the falls of timber are at once balanced by regeneration or replantation; and in the latter case, under the law of 1898, the State undertakes the charge of the woodland operations for the benefit of the proprietors—private, communal, or corporate—and merely charges the expenses of management, while otherwise leaving the proprietary rights untouched. This official supervision extends to 7,125,000 acres of woodlands throughout over 7,500 parishes, and forming the collective properties of nearly 16,000 landowners.

The total forest area in Hungary aggregates about 22,500,000 acres, or nearly one-third of the land surface of the country and is equal to 1½ acre per head of the population. Of this, 965,000 acres are purely protective woodlands and 297,000 acres are on shifting sand, while the economic woodlands consist of 17,068,000 acres unsuited for agriculture, and 4,200,000 still wooded, but suitable for clearance and agricultural occupation in due course of time, when an increasing population may render this necessary. More than one-quarter of this total area is under oak (5,970,000 acres) while beech and other broad-leaved trees cover more than one-half (11,760,000 acres), leaving less than one-fourth under conifer crops and chiefly the Austrian pine (4,800,000 acres). The State is the largest woodland proprietor, owning over 3,950,000 acres, roughly valued at about £8,958,000; and in setting an example to private and corporate owners the State as the largest proprietor has recently been very active in sylvicultural operations, such as the opening up of woodlands by light railways and the improvement of pasturage in mountainous districts. In all, 1,680 acres are maintained as nurseries, and furnish 100,000,000 young trees annually for planting. Of these over 42,000,000 are annually distributed free for the afforestation of barren tracts, which are being planted at the rate of 10,000 acres a year, and where the work is being done by private or corporate owners grants in aid are made by the State. The value of the annual yield in timber and other forest produce is about £3,500,000 on the spot, but is, of course, much higher when once this raw material is in transport. About nineteen-twentieths of this is utilised in Hungary itself, while only one-twentieth, valued at about £3,125,000 as worked up for export, is now exported and chiefly to Germany. The precise extent to which forestry provides employment throughout Hungary cannot be accurately estimated, but in all the mountainous tracts, as in the Tatra and Transylvania, forest operations and pasturage afford by far the chief means of livelihood to the population.

To provide fully for technical education of forest officers there is a High School of Forestry at Selmecz-bánya, better known as Schemnitz, sixty miles north of Buda-Pesth, the capital.

Originally merely a "mountain school" for miscellaneous practical instruction, it was in 1770 raised to the dignity of an Academy, and in 1807 a forest institute was added to it, and lectures were begun in 1809. Until 1867 the instruction was given in German, but since then the Magyar, or Hungarian language, has been enforced. In 1904 a reorganisation took place, the Academy becoming converted into the Royal Hungarian Forest High School, and put under the supervision of the Minister of Agriculture, although the administrative authority is vested in the Minister of Finance. The course of study extends over four years, and free tuition is supplied to candidates for admission on their producing a final pass certificate from a middle-class school. Besides all the usual branches of forestry and the cognate sciences generally, special courses of lectures are given on agricultural physics and chemistry, hygiene, climatology, plant pathology, pomology, hunting and the use and care of arms, pisciculture, practical administration and accounts, and civil and commercial law. There are six special chairs for forestry and the cognate sciences, and also seven chairs for subjects common to mining and forestry. After completing this four years' course satisfactorily and passing two years in practical work the State examination, held twice a year in Buda-Pesth, is undergone; and thereupon the candidate receives his diploma and becomes eligible for official employment. This high school is provided with good scientific collections, a fine library of about 30,000 volumes, two botanic gardens close at hand, and 825 acres of woodlands about three miles distant. There are thirty State and eight other scholarships, worth about £30 a year each, open to students, and a travelling scholarship of £100 open to graduates, while a Students' Aid Society, to which all must subscribe 10s. on first enrolment, assists poor students to the total extent of about £150 a year.

In the training of foresters or subordinate forest officials, to whom the administrative management of some of the smaller forests may be entrusted, under a law of 1889, four foresters' schools have been founded during the last twenty-five years at well-wooded centres—Király-halma, near Szabadka or Theresienstadt, in 1883;

Vadászerdö, near Temesvár, in 1885; Liptóújvar in 1886, and Görgény-Szentimre in 1893. The course at these practical schools extends over two years, and concerns itself chiefly with forestry and hunting, the theoretical instruction in forestry and the cognate sciences being subordinate to a thorough practical training for two years in all the duties appertaining to foresters and forest rangers, the main objects in view being to train the young men to become expert enough to act independently whenever necessary, and to be able to train as well as to supervise their workmen in the woods. Besides having large nurseries attached to them, these four foresters' schools have small forests close at hand specially made over to them, Király-halma having 950 acres, Vadászerdö 1,670 acres, Liptóújvar 385 acres, and Görgény-Szentimre 2,045 acres. Pupils are received from seventeen to thirty-five years of age, on production of four elementary school certificates. Accommodation is only provided for 168 pupils, eighty-four passing out each year, and the other eighty-four entering. Most of them are educated at the expense of the State or of corporate or private landowners, but some have to pay their own expenses, amounting to about £13 15*s*. a year, for board, lodging, and clothing. Each school has a staff of three teaching foresters—a director and chief instructor, and two assistants—who provide the whole of the indoor and outdoor teaching. After passing the two years' course satisfactorily and obtaining a school certificate, pupils go through one year's practical work elsewhere, and can then proceed to the forests technical examination and obtain a certificate of qualification as ranger on completion of their twenty-fourth year of age; and pupils at these schools are only called in for military service after completing the course. A reorganisation scheme is now under consideration for these four forest schools with a view of improving the instruction still further and of providing larger forest areas for practical work and outdoor teaching. From the nurseries attached to these four schools 15,000,000 plants are annually distributed for the afforestation of waste land, and small game is also being reared to improve the sport in the national forests. Forest experimental stations are attached to the high school and the four foresters'

schools, where very interesting investigations are being made under the superintendence of the Central Experimental Station at Selmecz-bánya (Schemnitz); but even a record of these would trespass beyond the space allowed for this very brief outline of Hungarian forestry. To all those, however, who may be interested in the subject of afforestation a visit to this section of the Earl's Court Exhibition may be warmly recommended.—(J. NISBET, *in the Field.*)